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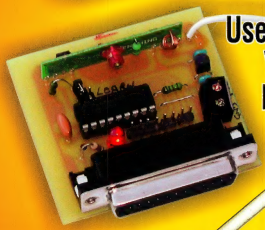

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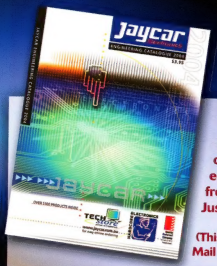

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More features see page 211

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See page 251 for more details

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Contents

Vol.17, No.5; May 2004

SILICON CHIP

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FEATURES

8 The Robocup – Robots Play Soccer
Robots playing soccer? You'd better believe it and there's more than one league to play in – by David Perry

18 Amplifier Testing Without High-Tech Gear
You don't need expensive gear to check out the performance of your hifi amplifier. Here's how to do it for peanuts – by Julian Edgar

38 Fly Rabbit Fly – Right Up To The sky
Yes, rabbits really can fly, especially when strapped into a rocket. But there's no fur, cotton tails or long ears involved here

78 Fluid Lenses – The New Way To Focus
Unique variable-focus optical lens system has no moving parts and could revolutionise digital cameras and security systems

Amplifier Testing Without High-Tech Gear – Page 18.

PROJECTS TO BUILD

24 Component Video To RGB Converter
Does your TV have RGB instead of component video inputs? This project lets you get the best possible pictures from your DVD player – by Jim Rowe

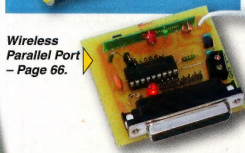
58 StarPower: A Switching Supply For Luxeon Star LEDs
It's based on a switching regulator IC, runs of 12V and is just the shot for powering 1-5W Luxeon Star LEDs – by Peter Smith

66 Wireless Parallel Port
Low-cost design uses a 433MHz UHF data link and can be used to control an 8-channel relay board – by Nenad Stojadinovic

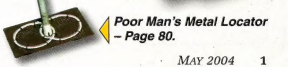
80 Poor Man's Metal Locator
It uses just five circuit components, is easy to build and works on the "beat balance" principle for good sensitivity – by Thomas Scarborough

Build A Component Video To RGB Converter – Page 24.

StarPower: For Luxeon Star LEDs – Page 58.



Wireless Parallel Port – Page 66.



Poor Man's Metal Locator – Page 80.

SPECIAL COLUMNS

33 Circuit Notebook
(1) Exit Sign With Battery Protection; (2) One ADSL Filter Serves Several Phones; (3) PICAXE-Based Home Security Project; (4) PICAXE-Based Car Speed Alarm; (5) Low-Cost Low-Intensity Alarm

40 Serviceman's Log
Nothing succeeds like a good whinge – by the TV Serviceman

73 Vintage Radio
Cataloging & disposing of your collection – by Rodney Champness

DEPARTMENTS

2 Publisher's Letter
4 Mailbag
44 Order Form
53 Product Showcase
57 Silicon Chip Weblink
85 Ask Silicon Chip
89 Notes & Errata
94 Market Centre
96 Ad Index

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PUBLISHER'S LETTER

High-priced power cords another fraudulent product

Every now and again a reader will send me a letter highlighting the fact that high-priced speaker leads and other hifi accessory products continue to be sold by hifi retailers. In fact, there is a letter on this topic in this month's Mailbag pages. These days I just tend to shake my head in continuing amazement at the apparently endless ignorance and gullibility of customers and the completely shameless exploitation of this credulousness by some hifi retailers.

We've seen it all before: oxygen free speaker cables with long grain copper; Litz-wound cables to avoid high frequency skin effect; directional interconnects; special video cables and so on. All wrapped up with technical-sounding mumbo-jumbo designed to confuse the already muddle-headed customer with money burning a hole in his pockets.

Considering their willingness to sell this high-priced rubbish, some hifi retailers make car salesman and real estate agents look like honest people. I will go further: How can you trust the recommendations of any hifi dealer who sells these accessories? One recent "innovation" involves interconnect cables with a 12V or 24V battery or 48V supply to supposedly bias the cable's dielectric. You can also have biased speaker cables, ranging from $1415 to $14,715 a pair.

The shyster who promotes this nonsense maintains that the "reason your equipment and cables sound better when you leave the power turned on...is because you are partially biasing the dielectric material in every component." What can I say? It leaves me speechless. The whole product category should probably be referred to Consumer Affairs. They could have a field day with it.

In their defence, hifi retailers will probably state that all their customers who buy these high priced cables are highly satisfied, with no complaints. Of course that is to be expected, isn't it? If an ignorant person buys a technical product with an expectation that it will sound better, it is no surprise that he thinks it does sound better. And if it doesn't, he is not likely to admit that he has been dudded.

But perhaps the worst example of hucksterism has to be the recent emphasis on special power cords, as produced by companies such as Shunyata Research. We are talking real money here; hundreds of dollars for a power cord! I really think the principal of the company must be laughing up his sleeve (and all the way to the bank) at his feckless customers. Shunyata, usually translated as "emptiness", "voidness", "nothingness" or even "relativity", is a key technical and philosophical term in the Mahayana Buddhist tradition. You don't believe me? Just do a Google search on "shunyata". To top it off, all the product lines are named after snakes. Is that "snake oil" or what?

Even worse, there is an Australian company in on the act. Just goes to show that when it comes to making a buck, Aussie companies are right up there.

Worst still, overseas "hifi" magazines such as the "Absolute Sound" give ringing endorsements to these products. It makes you wonder what special medication they are taking. Or what kickbacks?

Perhaps the final comment should come from my good friend Poul Kirk at Elan Audio, specialist audio manufacturer. As a joke, he has put together a power cord which passes through a black plastic box. The box is supposedly filled with specially imported elephant poo. He says that poo from Australian elephants just isn't good enough. Perhaps the imported elephant poo has added impurities from wildebeest (Gnu poo?) for special dielectric doping effect. Whatever. But you can bet that Poul Kirk's special power cord would "sound" at least as good, and possibly even better, than anything from Shunyata Research. I will leave you to draw your own conclusions.

Leo Simpson

Computer bits? We've got the lot!

LCD Monitor Arm

Holds 14", 15" & 17" LCD monitors. Supports up to 8kg. 3 in 1 design - desktop, wall and clamp mounting. Standard VESA mounts.

Cat 4666-7 **Monitor Arm** $99

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This USB connected phone allows free calls across the internet using third party software. Just plug into a USB port, no drivers needed. Operates with NetMeeting, MSN Messenger, Skype etc.

Cat 10128-7 **USB Net Phone** $89

Bluetooth Head Set

Go hands free with your bluetooth phone.

Cat 11907-7 **Head Set** $199

Bluetooth Serial Cable Replacement

This module is unique! Turn any serial device into a wireless device with this bluetooth adapter for the device end

Cat 11908-7 **Serial Cable Replacement Device** $459

Front Access PC Card Drive

This unit is an ATA Flash card drive which connects to the IDE connector of a standard PC. It reads full size ATA flash cards and supports Win98/ME/2000/XP

Cat 6666-7 **PC Card Drive Hot Swap** $99

Front Access PCMCIA Drive

This "drive" supports two type I or one Type II card with full PCMCIA compatibility.

Cat 6482-7 **PCMCIA Drive Front Access** $321

PC CardBus Sockets

Transfer your PC CardBus (32 bit) and PCMCIA (16 bit) based data to your desktop PC. This "drive" has two rear slots and supports Type I, Type II and Type III PC Cards.

Cat 6523-7 **PC CardBus Drive** $199

USB Smart Card Reader/Writer

The package includes API Library, Demo Program and Demo Source code and is suitable for applications in security control, loyalty programs, EDI, Kiosks, PKI and eCommerce etc.

Cat 8981-7 **Smart Card Reader/Writer - USB** $139

Dual Video Capture Card

An integrated DV (digital video) and AV (analog video) input all-in-1 PCI interface card.

Cat 3526-7 **Two in One - DV and AV** $249

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If your application program locks up, these watch dogs will apply a hardware reset to the computer after a selectable period.

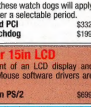
Cat 17070-7 **Watch Dog Timer Card PCI** $332

Cat 17084-7 **USB Auto reset - Watchdog** $199

Touch Screen Overlay for 15in LCD

This touch screen fits over the front of an LCD display and connects to the PS/2 port of a pc. Mouse software drivers are included.

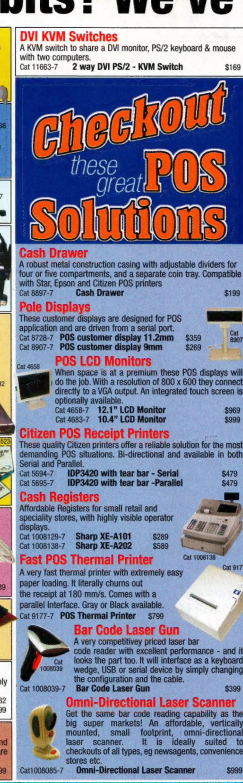
Cat 4353-7 **Monitor Touch Screen PS/2** $699



DVI KVM Switches

A KVM switch to share a DVI monitor, PS/2 keyboard & mouse with two computers.

Cat 11663-7 **2 way DVI PS/2 - KVM Switch** $169



Cash Drawer

A robust metal construction casing with adjustable dividers for four or five compartments, and a separate coin tray. Compatible with Star, Epson and Citizen POS printers

Cat 8887-7 **Cash Drawer** $199

Pole Displays

These customer displays are designed for POS application and are driven from a serial port.

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Cat 8907-7 **POS customer display 9mm** $269

POS LCD Monitors

When space is at a premium these POS displays will do the job. With a resolution of 800 x 600 they connect directly to a VGA output. An integrated touch screen is optionally available.

Cat 4658-7 **12.1" LCD Monitor** $969

Cat 4683-7 **10.4" LCD Monitor** $899

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These quality Citizen printers offer a reliable solution for the most demanding POS situations. Bi-directional and available in both Serial and Parallel.

Cat 5694-7 **IDP3420 with tear bar - Serial** $479

Cat 5695-7 **IDP3420 with tear bar -Parallel** $479

Cash Registers

Affordable Registers for small retail and speciality stores, with highly visible operator displays.

Cat 1008129-7 **Sharp XE-A101** $289

Cat 1008138-7 **Sharp XE-A202** $589

Fast POS Thermal Printer

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Cat 1008039-7 **Bar Code Laser Gun** $399

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Get the same bar code reading capability as the big super markets! An affordable, vertically mounted, small footprint, omni-directional laser scanner. It is ideally suited to checkouts of all types, eg newsagents, convenience stores etc.

Cat1008085-7 **Omni-Directional Laser Scanner** $999

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Lets your computer receive information and control a large range of external devices even from a remote location.

Cat 17074-7 **8 CH Opto DI 8 CH Relay Output PCI Dec** $399

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This very small footprint computer measures only 330x280x100 and utilises a standard ITX motherboard

Cat 1149-7 **Micro Footprint PC** $499

For mobile or remote site applications, this computer only needs a 12 Volt supply

Cat 1150-7 **12 Volt Embedded PC** $749

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These splitter modules enable multiple monitors to share the same information off a host PC simultaneously. The units also boost the VGA signal allowing distances up to 75m from the local machine.

Cat 3070-7 **VGA Splitter 2 way Max Distance 75m** $199

Cat 3055-7 **VGA Splitter 4 way Max Distance 50m** $259

Cat 3056-7 **VGA Splitter 8 way Max Distance 50m** $379

Throw away your old fashioned keys....use RFID

RFID (Radio Frequency Identification) is the new contactless way of opening doors, tracking goods, etc.

Cat 1008082-7 **Electrically operated door lock** $189

Cat 1008081-7 **All in one controller & sensor** $349

Cat 1008079-7 **Stand alone controller** $269

Cat 1008080-7 **RFID reader 80mm range** $209

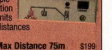
Cat 1008057-7 **RFID reader 200mm range** $269

Cat 1008108-7 **RFID reader RS232 connection** $199

Cat 1008083-7 **RFID card 0.8mm thick** $4.50

Cat 1008058-7 **RFID card 1.8mm thick** $3.25

Cat 1008059-7 **RFID key-tag** $6.50



RFID & Finger Print Readers

Control access to your premises and maintain a record of all comings and goings. Virtually any combination of Keypad PIN, RFID tag and/or fingerprint reader can provide the level of security you choose. Optional access management software allows control via an RS232 or RS485 link to a PC.

Cat 1008142-7 **RFID & Finger Print Reader/Controller** $1,999

Cat 1008143-7 **RFID Reader/Controller - LCD Display** $549

Cat 1008145-7 **Access Control Software** $399

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Cat 5448-7 **Business Card Cutter** $249

Surveillance Equipment

Keep an eye on things with our range of surveillance equipment.

Cat 3429-7 **4 Camera input Kit** $899

Cat 3491-7 **Dome Style colour camera** $249

Cat 3489-7 **Dome Style B&W camera** $96

Cat 3496-7 **B&W camera - IR illumination** $114

IP Addressable Cameras

Run an ethernet connection straight from the camera to monitor your video feeds locally or remotely.

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MAILBAG

Digital TV has aspect ratio problems

Being the owner of a wide-screen TV connected to a digital set top box probably puts me in the minority for the moment among TV viewers. This may be the reason why a current problem with digital TV aspect ratio is receiving no comment from the viewing public.

The problem is that some TV programs and commercials on all channels, when viewed on a wide-screen TV, are wide-screen (16:9) but are shrunk, meaning that there is a black border all the way around. It is as if you need a zoom control to zoom in on the picture so it will fill the complete screen.

After considerable contact with SBS, who have this situation more than other channels, the answer was figured out. It took some doing, as my original queries were not understood and I received a lot of information about aspect ratios but not about the problem. After photographing my analog 4:3 and digital 16:9 TV pictures when this condition existed, the problem was understood (by SBS).

TV in Australia is in transition, not just with analog to digital but also 4:3 to 16:9 and this change of aspect ratio is a difficult one when the TV stations have to try and satisfy two different consumer demands.

Only the Nine and Ten networks have full 16:9 studio capabilities, while the others have limited 16:9 studio capabilities or none. For example, some two years on, only channels Nine and Ten transmit their news in 16:9 on the digital service.

When a program is fundamentally 4:3 but with inserts of 16:9 material, there are two options: (1) crop off the sides of the 16:9 picture; or (2) show the 16:9 material in letterbox format. This means that the 4:3 analog viewer sees the studio-based picture (for example, the presenter) in 4:3, filling the screen with no missing picture.

When the 16:9 inserted material is then shown, the analog viewer sees this material in letterbox with a black bar at the top and bottom. This is because the program people want the analog viewer to see all of the 16:9 picture.

But what happens for the digital viewer? The digital viewer sees the studio-based program (the presenter) in 4:3, meaning a black bar on the left and right but not on the top and bottom. However, when the 16:9 inserted material is shown, which is now treated as letterbox, the picture remains "4 units" wide (black bar on left and right) but now has a black bar at the top and bottom as well in order to maintain a 16:9 aspect ratio (ie, it gives a small 16:9 picture).

It may be difficult to get your head around the problem, as it is a complex mix of different aspect ratios. There is a solution, other than convert the studio to 16:9, and that is an aspect ratio converter on the digital transmission feed that is switched to convert letterbox to 16:9. This however has its own problems, one of them being cost.

By the way, owners of 4:3 TV sets connected to a set-top box and set up for 16:9 viewing on the set top box and the TV experience the same problem.

So if you have wondered why you have a brand new wide-screen TV but with a shrunken picture, it is because of the difficulty of mixing 4:3 and 16:9 during this transition phase.

Will McGhie,
Lesmurdie, WA.

Uninsulated wiring a hazard for current clamp adaptor

I am assembling the current clamp adaptor for DMMs, as described in the September 2003 issue. It occurred to me that the insulation of the supplied battery clip (as used in the original project) may not be adequate when measuring current in high voltage AC/DC circuits.

As an industrial electrician, I frequently use a "clip-on" in control cabinets, etc where there is a possibility of contact with the 240VAC mains. Employer provided clamp-meters have insulated jaws. There appears to be no mention of the possibility of an electric shock or creating an arc when using this type of clip.

The toroid ring provided is also conductive. I have purchased another larger all-insulated battery clip from Jaycar that should be safe. I will shift the Hall Effect sensor to the pivot end of the clip. Can it be mounted in-line with the toroid ring? The original set-up is mounted at 90° to the toroid.

I. J. McPherson,
via email.

Comment: we should have mentioned that the clamp adaptor is not suitable for use with 240VAC mains when the wiring is uninsulated. The Hall Effect sensor detector can be rotated 90° as you suggest.

If cars were priced like VCRs . . .

Recently, I bought a $98 Dick Smith branded VCR from Tandy. I can't believe that this good-looking, feather-light 14W 4-head machine could be had for *one-sixteenth* the dollar price I paid for my first VCR over 20 years ago! And it comes with a crystal-locked 30-odd channel UHF modulator – no stupid "Video/TV" switches required.

If car pricing went the same way, we'd be able to buy a basic sedan now for around $1,000! Peeping inside, it's obviously been built by robots and as for more than basic repairs, forget it! But at that price who cares?

What I was curious about is whether you've heard if there has been some sort of relaxation of the RF standards required for the importation of TV receivers into Australia.

When just about all of Europe standardised on a video IF of 38.9MHz in the

early 60s, the Australian authorities decided upon the oddball frequency of 36.875MHz. The theory behind this seemed sound enough at the time: nobody in Australia would transmit anything on that frequency, reducing the possibility of mutual interference.

Back when TV sets used valves, this may have been a valid concern but such problems have long since vanished with the proliferation of SAW filters and compact IC IF amplifiers. However, at least in the early days of colour TV, it no doubt served as a convenient excuse to make things just that little bit more difficult for importers, since TVs would have be specifically made in smallish batches for the Australian market!

Recently I've noticed that all seems to have gone out the window, and even bargain-basement TVs and VCRs seem to be able to be set up to work anywhere in the PAL world! A $148 14-inch TV I also recently bought worked faultlessly on PAL, NTSC (both 4.43MHz and 3.58MHz) and PAL-M! There are no glass delay lines, coils or filters either, just one big SMD IC and two crystals. It's all done by switched-capacitor filters and delay lines. And done very well! And with none of your fancy subcarrier-multiple crystals either, just bog-standard 4.43MHz and 3.58MHz rocks! They don't even have trimmer capacitors!

And where I can actually get a look at the IF SAW filter, they all now seem to be the Euro-standard 38.9MHz. In most cases now, the IF and tuner are all in one unit which makes prying a trifle difficult these days.

It says something about economies of scale, doesn't it? Already, most DVD players can be set up to operate as PAL or NTSC machines. In a few years I can see TVs and VCRs becoming truly "international" with tuners that can handle just about any VHF or UHF transmission, or standard, whether digital or analog. It's also been some years since I've seen a TV or VCR that doesn't work perfectly with a mains supply anywhere from 80VAC to over 260VAC (which is as high as my Variac goes).

Keith Walters,
via email.

Comment: we don't know of any specific relaxation but it occurs to us that provided a TV, VCR or whatever met the various safety standards and could be demonstrated to "work" satisfactorily on Australian transmissions, then local distributors would have no compunction about releasing the product on our market.

Expensive loudspeaker cables are a con

It was interesting to read the Publisher's Letter in the February 2004 issue, about the cons of electronic corrosion control. Another con that I feel is being promoted by some hifi and electronic component stores relates to the use of "monster cable" for speaker connections.

In a normal home situation I cannot see the justification for using such expensive cable when possibly good twin-core flex (say 7.5A rating) would suffice. I would defy anyone (with good or poor hearing) to pick the difference in sound quality between one system using "monster cable" and another using good twin-core flex.

Trevor Butler,
Hadfield, Vic.

Comment: 7.5A twin-core cable is not good enough for a really good high-end system. You really do need thick copper cables to get the speaker cable resistance down to a fraction of an Ohm. The more copper, the better.

The low resistance is needed to maintain the high damping factor of modern amplifiers but more importantly, it does have a measurable and audible effect on the upper treble response of speakers, particularly those that have a falling impedance at high frequencies.

That said, it does not justify the huge cost of some speaker cables.

Vintage Radio restorers should replace capacitors

I am very concerned at the following statement in the Vintage Radio article in the January 2004 issue: "most of the capacitors in this design can be quite leaky without causing any harm". In fact, there are many places in a radio circuit where a leaking capacitor will cause problems, ranging from distortion to the destruction of other components and, in some cases, fire.

It was indeed unfortunate that non-leaking capacitors were not available

Atmel's AVR, from JED in Australia

JED has designed a range of single board computers and modules as a way of using the AVR without SMT board design

The **AVR570** module (above) is a way of using an ATmega128 CPU on a user base board without having to lay out the intricate, surface-mounted surrounds of the CPU, and then having to manufacture your board on an SMT robot line. Instead you simply layout a square for four 0.1" spaced socket strips and plug in our pre-tested module. The module has the crystal, resetter, AVR-ISP programming header (and an optional JTAG ICE pad), as well as progamming signal switching. For a little extra, we load a DS1305 RTC, crystal and Li battery underneath, which uses SPI and port G.

See JED's www site for a datasheet.

AVR573 Single Board Computer

This board uses the AVR570 module and adds 20 An./Dig. inputs, 12 FET outs, LCD/Kbd, 2xRS232, 1xRS485, 1-Wire, power reg. etc. **See www.jedmicro.com.au/avr.htm**

$330 PC-PROM Programmer

This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.

Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

JED Microprocessors Pty Ltd
173 Boronia Rd, Boronia, Victoria, 3155
Ph. 03 9762 3588, Fax 03 9762 5499
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to the radio trade until the advent of the Philips Polyester capacitors in the late 1950s. Up until this time, paper capacitors were commonly used and these were notorious for becoming leaky. In other words, they became the equivalent of a capacitor with a resistor across it.

Every old paper capacitor left in radio is a potential problem with perhaps the exception of the RF and IF cathode bypass ones. It makes good sense to replace all these old capacitors as a matter of course. The point is that this leakage increases with time. A radio may work in a fashion now but trouble can be expected in future. The modern replacements appear to be everlasting and therefore well worth the trouble.

The article states it is essential to replace the audio coupling capacitor. This is certainly an important one but why only in a set without AGC? Surely a leaking capacitor in this position is going to play havoc regardless. AGC has nothing to do with it (was this a typo?).

I believe a well-restored radio will be around for many years to come so we owe it to posterity to make as good a job as possible of the restoration. The following is a list of some of the points in a typical radio circuit where a leaky capacitor could cause trouble:

(1). The screen bypass. Leakage here lowers the screen voltage and overloads the screen-dropping resistor which may go up in value or even burn out.

(2). As above with the B+ supply to the heterodyne oscillator.

(3). Most sets have a RF bypass from the B+ line to earth, usually 0.1µF or more. This item is prone to failure after restoration. A dead short here could (and has) caused the power transformer to catch on fire.

(4). Leakage in AGC bypass capacitors will cause overload distortion on local stations.

(5). Some sets use an audio driver such as a 6B6G with a 10MΩ grid leak resistor to develop a small amount of grid bias. The coupling capacitor here isolates the grid for DC thereby keeping the valve working in the straight portion of its characteristic curve (class A). Leakage in the capacitor will cause distortion.

(6). As mentioned, no leakage can be tolerated in the audio coupling capacitor between the driver stage plate and grid of the output valve.

A typical radio circuit will therefore have very few paper capacitors that could safely be left in the set. Most restorers simply replace them all as a matter of course. Replacing the electrolytic capacitors as a matter of course is also good insurance. I do leave the mica capacitors in place as they rarely give trouble. All resistors should also be checked and those out of tolerance replaced.

Ted Baker, VK2ABW,
via email.

Rodney Champness replies: I agree with Ted Baker's statement in the last sentence of his first paragraph and I agree with all of the second paragraph. However, I feel he has gone overboard in his almost blanket condemnation of paper capacitors, as many are still usable with acceptable leakage resistance.

While replacing every paper capacitor may be an easy approach, the question could then be asked "How many 1930s sets had polyester capacitors?" We are taking away the authenticity of our restoration projects and no one will know what a paper capacitor looks like! I think this is important too, don't you?

I know one restorer who takes the old capacitors out of a set, removes the insides and then inserts polyester capacitors. If a restorer has the time and patience to do this, the set will look original. A set converted this way would then need to have a placard in it pointing out that "The capacitors in this set ARE POLYESTER therefore do not replace unless definitely proven faulty"!

In a set without AGC the most important capacitor to have little or no leakage is the audio coupler. I did not say that I didn't replace it in a set with AGC, as I was only talking about a set with no AGC. Previous articles show that I replace the audio coupler AND the AGC bypass capacitors as a matter of course. An audio coupler should, in my opinion, have no less than 50MΩ leakage resistance, and higher resistance in some circuits. A paper capacitor would automatically be replaced as it is unlikely to meet this requirement, when tested as I suggested on page 88 of the article.

I agree with the six points Ted Baker makes on possible consequences of faulty capacitors. Now let's look at how bad paper capacitors really are. In the critical spots that I consistently mention in my articles, no leakage below the 50MΩ mark can be tolerated. Nor would I consider using a capacitor with below 5MΩ leakage in other locations in a set, with rare exceptions.

The RF bypass on the HT line needs care in assessing its suitability to remain in the set. I would measure it as I have indicated in the article. However, if the test indicates the capacitor is OK, I would then put it back into the set, turn the set on and keep an eye on it. I would then touch the capacitor after a short time (after switching off!) to see if there is any build-up of heat in it. If there is, the capacitor is removed as it will short out or explode after a little while.

Screen bypass capacitors can't be checked in the same way. In this case, measure the voltage across them and if it drops more than a few volts, the capacitor is suspect and should be given the heave-ho.

After a restoration job, any set should be left running under supervision for quite a few hours to make sure ANY component (capacitor, resistor, transformer, valve, etc) that breaks down is caught before significant damage is done.

Paper capacitors ARE the most troublesome components in vintage radios but some brands are better than others. In my experience, the worst were the 1940s and 1950s Ducons and UCCs. Many of the old Chanex capacitors and some of the AWA "moulded mud" capacitors are OK, despite their age. I do however, suggest checking all of them.

Old scopes were built to last

I recently bought two Tektronix 475 analog 200MHz oscilloscopes from Oatley Electronics for the princely

sum of $500 each plus 10% GST. I used to use these when I was serving our country in the RAAF from 1972-1992. I think we saw these about the later part of the 1970s. Before that we were using Tektronix 545s which contained so many valves that you could just about keep your tea hot sitting on top of it. The scope was so large that it had to be wheeled around on a trolley especially designed for the task.

By contrast, the 475 was compact and fully solid-state except for the CRT. It weighed about 11kg so it was easily moved about. Looking inside these 475s, one can see the quality of manufacture, with gold plating on switch contacts and connectors everywhere. Not just a flash either but quite thick gold plating judging by the colour of it. High quality components too, for the time; no planned obsolescence that we see in equipment these days. This was a piece of test equipment made in 1974, built to last with no cost spared in the manufacture.

Thirty years on there were a few faults of course; mainly noisy pots. This was rectified by injecting Servisol contact cleaner and lube into the pots concerned. The only major fault I found was in channel one's attenuator in one of the instruments. It manifested itself as an increase in gain in the 0.5 to 5V divisions. Either the x100 attenuator circuit module was faulty or the switch contacts that brought it into use were dirty. By just touching the x100 attenuator plug-in module the fault would clear itself. I swapped this module with the one in channel two and the fault cleared.

So there it was, one faulty x100 module. Not repairable according to the service manual – thank the Internet. What did techs do for information before it was born?

As they say, nothing ventured, nothing gained. I very carefully prised the top off it and under a maggylamp saw a very brittle solder joint. I resoldered it with a 1mm tip soldering iron and 0.35mm 3% silver solder (I repair camcorders too), refitted the module and it all works well.

It's a pleasure to work on equipment that was built with quality in mind rather that the mostly poorly built gear that comes out of China. But that is the main-stay of consumer electronics these days and most is just throw-away; not worth repairing.

I think anyone requiring test equipment would do well seeking out the used quality equipment offered by Oatley and others, rather than buying new but inferior items. By the way, the Tektronix 475 oscilloscopes cost about $3900 (US dollars) new in 1974. I don't think I was being paid that much a year then.

Bob Scott,
via email.

How much light from LED driver?

I have a few observations regarding the LED driver article in the March 2004 issue. I understand it's an Oatley Electronics creation but even so, I would expect you to have had access to the finished result for long enough to test it and most importantly give some idea of its output.

I tend to be cautious about time and money, not seeing the value in building something that is going to (possibly) have noticeably less performance than a "bought one". Often, I've seen a kit costing close to or even more than a finished product from one of your regular advertisers.

I foresee a few more LED projects in the pipeline, seeing as one of your advertisers is selling a near "equivalent" of the Luxeon Star at half the price, so it would seem timely and very useful to have some repeatable standard for rating these projects.

Might I suggest as an example, a 5W or 10W festoon automotive lamp, either bare or against a 75mm round white card, to simulate the effect of a "typical" (no such thing!) interior vehicle light fitting. Or even use the genuine article.

You could express the output in Lumens, candelas or simply as "usable" or "heaps brighter" or "able to read the fine-print on a politician's promise"! Obviously SILICON CHIP is a hobby/interest magazine, so ISO standards need not apply but some repeatable, approximate idea would be appreciated.

So the question remains: how bright are the 10, 20 and 30-LED versions compared to, say, a car interior lamp? Personally, I'd rather pay $50 or so for a twin compact high-efficiency fluoro from Jaycar, knowing it IS much brighter, than risking $34 (plus cost of housing) on something that might be even better still or the same.

James Longmire,
via email.

Comment: light measurements along the lines you propose are not all that easy because we are not comparing like with like. Subjectively, the 10-LED "lamp" of the 30-LED array is about as bright as a 10W festoon lamp but the colour and light distribution are quite different, as you would expect.

Electronic corrosion control debunked

Thanks for writing the February 2004 Publisher's Letter on electronic corrosion control units for automobiles. The same sceptical opinion was expressed by the late Harry Webster in a Viewpoint editorial entitled "Cars and Cathodic Protection – Watch Out For Fraudulent Gadgets" which appeared on page 8 of the June 2001 issue of *Materials Performance* magazine.

That magazine is put out by NACE International (formerly known as the National Association of Corrosion Engineers) in Houston, Texas. Harry had been the president of NACE and was an expert on cathodic protection.

Richard Garber,
Portland, Oregon, USA.

Valve equipment gave that warm feeling

I agree with your editorial comments about the "mediocre" performance of valve amplifiers compared to today's technology using silicon based devices. However, some of us remember the cold days of winter in far-off regions servicing radio navigation and communications type equipment, consisting of many racks of electron tubes/valves circuitry – there was never a problem staying warm. Of course, in the summer time it was a different story!

There's one other advantage of valve technology – which we all hope never comes to fruition. In the event of a "big bang" of the nuclear variety, there'll be more valve amplifiers left standing than the semiconductor species after the EM pulse hits them.

John Bond,
via email.

Machines playing soccer? Better believe it!

Roboc

Since 1997, teams from across the world have been competing to build the perfect soccer-playing robots, in hope of one day developing the technology to such a level that it may compete against, and beat, the human world cup champions.

by David Perry

The challenge for roboticists is developing machines that may think and act autonomously, able to analyse sensory data and act in a meaningful way, as a human would.

It was once thought that getting robots to act intelligently in the real world would be a fairly trivial step beyond computer simulations of such an environment. Several decades later, we now appreciate the complexity of the tasks that nature manages with such apparent ease.

Despite millions of dollars, countless postgraduate students, academics and corporations, robots can only begin to operate intelligently within a tightly controlled environment. Any attempt to generalise a vision or learning algorithm into something mildly human-like is met with little success and a great amount of frustration.

There are several factors which are making this technology evolve slower than we'd like. One is the inter-disciplinary nature of robotics and A-I (henceforth just called intelligent robotics). Robotics researchers may have a background in any number of engineering and scientific fields: computer science, cognitive sciences, mechanical, electrical or software engineering.

Everything breaks – and interacts!

I like to think that robotics involves Murphy's Law cubed. The mechanics break, the electronics break and the software breaks! There are all kinds of interactions within and between these systems, challenges spanning multiple fields of engineering and sometimes aspiring to emulate the natural world.

Computer-based systems can evolve because there is some standardisation amongst hardware and software. Everyone knows about C++ and has access to (and uses) PCs. But complete off-the-shelf solutions are not common in robotics. Researchers often begin by building their own mechanical platform, selecting and designing wheels, legs, motors, the chassis...

Then they build motor controllers, select batteries, design controllers or work out how to use a PC or notebook computer in their design. Only a handful of companies build wheeled robots (or humanoid robots) for sale to researchers. And then they tend to be expensive and not optimal for particular research interests. In building robots, there are just too many design considerations, technology that needs to be implemented but which is not yet mature. Everybody goes off on their own research tangent and, as such, tend to develop everything from scratch, by themselves.

Soccer is the equaliser

One aim of the RoboCup Federation is to overcome these difficulties by providing a standard, scalable problem. That standard is the game of soccer, with a number of "leagues".

The challenge begins with playing soccer in simulation and in well lit environments with well-defined, coloured markings. The rules slowly evolve so that as the environment rules become less stringent, the robots become more robust, adaptable and, hopefully, more intelligent. Every year, the rules of each league are reviewed with aim of encouraging innovation. Field walls have been removed in some leagues and eventually colouring and lighting requirements will be relaxed.

The idea is, once the ultimate challenge is fulfilled, robots will have matured to such a state that they will be feasible in everyday life. Of course, there is some way to go.

The most developed robotic league in RoboCup is called the F-180 or small-size league. The '180' denotes that robots may have a footprint no larger than 180cm^2 – although the

Depending on the league, control can be as simple as one notebook computer – or a computer for every robot. Most work on wireless LANs.

actual sizing requirements are now more complex.

The game is played on a green-carpeted field about the size of a ping-pong table. One goal is yellow, the other blue and the field is surrounded by a small ramped barrier which will keep a ball in play, provided it hasn't been struck too hard.

This league allows teams to use an overhead camera, connected to as much computing power as a team cares to bring with them. The computer can see the ball (an orange golf ball), the goals and every team member at all times. Local on-board vision is also allowed, although teams that use this exclusively tend to be not all that competitive.

The robots themselves may have a few sensors on board (for example infrared beam sensors to detect when the robot is in possession of the ball) and some low-level control electronics. The robots are commanded by RF from the host computer which outputs the behaviour for all of the robots. The robots are in teams of five, including a goal keeper.

The drive system typically entails either a differential drive (like a tank), or (more recently) omnidrive, which allows the robot to move in any direction, from any orientation. So where a robot with differential drive has to turn to the direction it wishes to travel, omnidrive can move in that direction instantaneously.

It achieves this using three or four omnidirectional wheels. As well as turning like a normal wheel, these have rollers that allow the wheel to move in the direction of its wheel axle. By varying the speeds of the wheels, the resultant drive and slip of the rollers allows the robot to move in any direction.

These robots also often include ball manipulation devices, including a kicker (usually a spring-loaded or solenoid mechanism) and ball dribbler (a rotating rubber coated bar on the front of the robot that induces a back spin on the ball, keeping it close to the robot even when travelling backwards).

It would be a reasonable assumption that a computer controlled F-180 team could defeat a team of humans playing with joysticks (at least until the humans got in a great deal of practice).

The F-180 league is relatively mature, games are extremely fast and teams implement complex behaviours including passing and blocking.

Middle-size league

The F-2000, or middle-size league is less mature. Like the F-180 league, the '2000' denotes that the robots may have footprints no larger than 2000cm^2. Their basic physical construction is similar to that of the F180 league, only scaled up. Bigger batteries, motors and beefed-up control electronics are required to deal with this additional load. This increases cost dramatically.

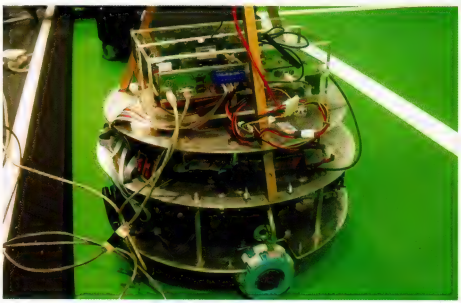
Their game is played on a larger field (8 x 12 metres) with a similar colouring scheme to the F-180 league. There is now only a white line at the field's edge, so the ball can be kicked out of play easily. At each corner of the field is a coloured post.

What makes this league far more challenging is the requirement for all sensors and processing to be on-board (an off-field 'coach' computer is permitted).

The robots must now play soccer, not always having a view of the ball, team-mates, nor the goals.

With the F-180 league, you could get by with one cheap desktop computer but F-2000 needs one for each robot, powered by batteries – either modified desktops, single board computers, or laptop computers.

Vision consists of one or more cameras on each robot. Some use cameras aimed at a convex mirror



This close-up give a good idea of the complexity involved in a soccer robot.

mounted above the robot, providing a panoramic view of the field. While this has the advantage of giving the robot the ability to see in all directions, the detail that can be viewed in a particular direction, especially at a distance, is reduced.

The standard of play in this league is much lower. Given the size of the field, robots seem to move more slowly. They tend to get caught on things, run out of bounds and can't manipulate the ball with the same agility as smaller robots.

The robots lack localisation (working out where they are) to the same accuracy and thus are limited in the complexity of strategies able to be taken.

Successful robots in this league tend not to be the fastest or most clever but well tuned to guarding their own goal and able manoeuvre a ball around obstacles towards the opponent's goals.

Humanoid league

The challenge takes a final step up in the humanoid league. These will be the robots that will hopefully face humans in a full-scale match in 46 years (2050 is the RoboCup organisation's target date).

At the moment, however, they're quite primitive. Robots can be in a number of size classes, some over 2m tall. The tasks they must complete include subsets of skills needed for an actual game (walking, penalty kicks, standing on one leg) and a one-on-one competition.

These robots can be enormously expensive to build. While wheeled robots need only a few actuators, humanoids can have dozens. The power requirements are considerable, as are the computational requirements (humanoid robots require very high speed control systems that can deal with balancing the robot in real time).

The development of humanoid robots is a story in itself. Honda spent decades and hundreds of millions of dollars developing their humanoid robots, ASIMO being the latest. These intensely engineered robots can make the whole task seem easy. They're often described as looking and walking like men in space suits.

Some robots in this league do have this level of agility and apply it in playing soccer. Game play at its best, however, is still very slow and delicate. The robot's foremost concern is staying upright so any attempt to kick or block a soccer ball comes second to maintaining balance.

This shows the long and the short of it: some of the humanoid-class robots stand 2m tall and cost a fortune to build . . .

Other leagues

There are four other leagues in the competition which complement the F-180, F-2000 and humanoid competitions.

The first of which is a ***simulation league***, where competitors create teams entirely in software.

Unhindered by hardware, they can focus on creating intelligent agents which are able to perceive environmental data provided by the 'soccer server' and formulate the necessary actions to be taken.

Software teams are played off against each other in the "virtual arena" of the soccer server and the game is shown on large screens throughout the competition.

The ***rescue league*** diverts completely from the game of soccer, aiming to provide an immediate practical application. There are two components to this league. The first is a simulation league where the behaviour of emergency responses (for example fire fighters) is simulated on a large scale.

It is hoped this research will provide data to assist emergency services in best distributing resources in disaster scenarios. The second consists of real rescue robots that may be sent into a disaster zone that is either inaccessible or too dangerous for human rescuers to reach.

The robots are varied, some having on-board sensors and intelligence. Others are tele-operated, either by radio or a cable dragged behind. In competition robots are sent through a

. . . on the other hand, there are little fellas in the RoboCup competition too.

They're cute to watch; the four-legged league is based on Sony's "AIBO" robot dogs and creates a level hardware playing field.

course of unknown configuration, and must avoid obstacles to find and map the location of potential survivors.

The 'survivors' are plastic mannequins which may have actuated limbs that shake, or heating pads to give the impression of a warm, alive body. The robots detect the survivors through vision, thermal detection or motion sensing. Similar robots were deployed at the World Trade Centre to search through the debris for survivors, unfortunately without success.

The scoring is dependent on the quality of data acquired and the amount of human assistance. In the future, the league will be expanded so that robots can perform additional rescue functions, such as administering first aid or reinforcing unstable structures.

Perhaps the cutest robots belong to the ***four-legged league***. Sony AIBO robotic dogs are programmed to play soccer, on a field similar to that of the F-180 league. Sony is a major sponsor of RoboCup so the league is good publicity.

But the fixed hardware also forces teams to deal entirely in software. In some ways it creates a fairer competition, as teams can't simply buy more powerful motors or computers to defeat the competition.

Every effort is made to extract maximum performance from the four-legged dogs. Extensive fine tuning of the walking gait ensures maximum speed and the robots often walk with their heads low to the ground and legs spread out to block or intercept the ball.

The Sony AIBO ERS-210A robot, one of the newer versions, has 20 degrees of freedom (DOF) throughout its four legs, head, ears and tail. The computing power on-board is roughly equivalent to a small PC or PDA, with its 64 bit RISC processor running at 384MHz.

The robots typically make use of wireless networking, as with other leagues, to communicate and also take game start/stop instructions.

The legged league may be cute and fun to watch but the game-play is still of relatively low quality. Despite the valiant efforts of their programmers, the robot's hardware is limited. The single on-board CMOS camera has limited resolution (176x144), the motors have limited torque and speed, and the computer has limited power and memory.

The situation will improve, with the latest version of AIBO, the ERS-7. This robot should make its debut at RoboCup 2004. It may well be that the league advances along with Sony's periodical release of newer, more advanced robots.

Who's playing – and paying?

The majority of participants in RoboCup are universities, with a small number of companies also putting forth teams. The costs of parts, travel and registration don't leave much room for the hobbyist.

However there is a concession in the form of ***RoboCup Junior***, a branch of the competition for primary and secondary school students. Where RoboCup focuses on fostering research, RoboCup Junior is about encouraging education in science and technology.

As with the main competition there are several leagues, including soccer, rescue and dance, each with set age groups.

The soccer league is either 1-on-1 or 2-on-2. Several changes are made from the grown-up version to simplify the technology required to compete.

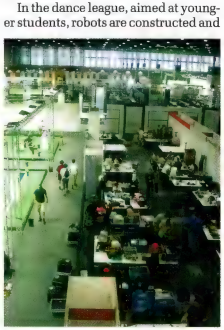
For example, the field has a monochrome gradient, rather than green carpet. By reading the field with a light sensor, a robot can judge its position along the length of the field. The goals are black at one end, and white at the other, also allowing them to be found with a simple light sensor rather than an expensive camera.

There are 140mm high walls around the edge of the field. Finally, the ball itself is a clear plastic shell with several infrared LEDs inside. Thus the ball can be found by scanning for the unmodulated infrared light emitted, using a filtered light sensor like a photodiode.

The junior rescue league is essentially a scaled down version of the parent. The course is smaller and has less obstacles. There is a line that a robot may follow that will lead it through all the various sections of the course, without the need for complex navigation.

The survivors are denoted by either a green or silver patch on the floor of the course. These colours can be differentiated with a light sensor, aimed at the floor.

In the dance league, aimed at younger students, robots are constructed and



In every RoboCup competition arena you'll find a "pit" area set up for last minute tweaks and of course repairs.

programmed to dance to a song for up to two minutes. Some have clever motorised limbs and timing, others are simply dressed up.

Robots were at first solely constructed using Lego Mindstorms. These Lego systems have sensors and controllers well suited to the junior soccer, rescue and dance leagues. Drive systems are also quite easy to construct. Advanced teams now use more customised hardware, including microcontroller boards and ultrasonic sensors.

Melbourne Uni team

I was involved with the University of Melbourne mid-size team, within the Department of Electrical and Electronic Engineering.

We competed at RoboCup2003 in Padua, Italy. It was the first year we had competed. This, combined with our extreme under-preparedness, proved extremely challenging. Due to delays in manufacture, much of the hardware was untested, up to the point that we were assembling things for the first time, just days prior to the competition (even on the plane to Italy!).

The MU-Wallabies, as we were known, had several design criteria in mind. One was the need for small, highly manoeuvrable robots. Also, an omnidirectional kicking device was designed. It consisted of a 'leg' which was able to be rotated about the robot's circular body.

Unfortunately, a number of problems arose. In order to fit in a kicking device that protruded from the robot's body, the body had to be quite small. This required that the wheels (we used differential drive) be close together and that the laptop computer used to control the robot be mounted vertically.

Ooops!

The first question we were asked about our robots, after being asked whether they could participate in "Robot Wars" (instead of Robocup!), is whether they will tip over. We were hoping software algorithms would prevent this from happening, although sometimes collisions or malfunctions would cause a robot to turn too tightly and fall over in competition – much to the opposing teams delight.

Also, the aim of having fast robots has yet to be fulfilled. The cheap motors and gearing used failed to perform to expectation and we've been forced to move to much more expensive precision Swiss-made motors with planetary gearboxes.

Our entire drive system, despite requiring custom CNC machined parts, only cost around $1500 per robot. The new motors alone will cost $1200 per robot. Additional problems included faulty wiring and overheated battery packs. All of these things were quite preventable but we simply lacked the time to catch all the bugs.

The laptops run a Slackware Linux distribution, and the C++ control code is compiled with GNU (open source) tools.

Inexpensive Logitech webcams are used for vision, through the USB port. They run on the Video4Linux drivers that are compatible with the Philips webcam chipset. Images of 320 x 240 pixels are captured and processed at a speed of about 10 frames per second. This maximum speed is a limitation of the webcam, and not the software or laptop. The software classifies regions in the image based on colour and makes a determination as to what the corresponding object is. It needs to be calibrated, as colours can vary depending on lighting conditions. The vision software provides polar coordinates (angle and distance) for each object in view on the field.

The next step in processing is either acting directly on this data, or using it for localisation. This process determines where a robot is in relation to the entire field. For instance, it may output a cartesian x-y co-ordinate, where the origin is in the centre circle. Through the 802.11b wireless network, robots can collate this information and build a detailed model of where everything is on the field.

Artificial intelligence software takes this information about the environment and works out what actions to take. In 2003, this software was extremely simple. That said, it did work surprisingly well and our main source of problems was hardware breakdown.

Australia is a strong, competitive participant in the RoboCup competition. Other institutions competing include the University of Queensland, University of NSW, University of Newcastle and University of Technology, Sydney.

In 2003, researchers from Australia took out both the Engineering Challenge Awards. rUNSWift from the University of New South Wales took first place in the Sony legged league, with the Nubots from the University of Newcastle coming in third.

One of the most exciting matches saw the RoboRoos of the University of Queensland facing BigRed from Cornell University in the US, in the F-180 final. Cornell has enormous financial and human backing, including Microsoft and NASA, and they have dozens of students and staff assisting.

Despite this, they were defeated in an earlier round-robin match by the University of Queensland. Unfortunately, Cornell managed a 1-0 defeat of the RoboRoos in the final, with the match having gone into overtime.

RoboCup 2004 is to be held in Lisbon, Portugal, from June 27 to July 5. If you would perhaps like to get involved, or just watch these robots in action without the expense of overseas travel, there may be a local alternative. RoboCup Junior has state and national competitions every year. For the more ambitious, the University of Melbourne mid-size RoboCup team is aiming to set up a wider robotics competition later this year that will be open to all. **SC**

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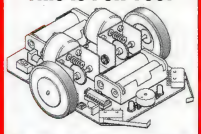

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DICK SMITH ELECTRONICS

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May 2004

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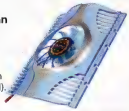

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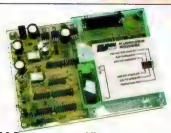

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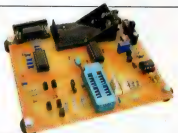

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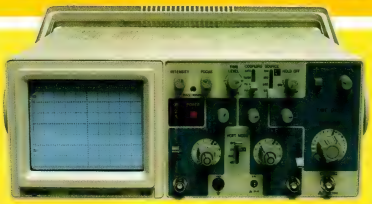

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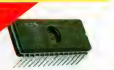

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You don't need fancy gear to check out audio amplifiers: just an input signal from a PC sound card, a multimeter, a loudspeaker, a wirewound resistor and a dummy load made from some electric jug elements suspended in water.

You don't need a bench full of expensive equipment to test audio amplifiers. Here's how to go about it using gear that's readily to hand.

By JULIAN EDGAR

Amplifier Testing without high-cost gear

IF YOU'RE ANYTHING like me, you can't resist picking up a bargain – especially when it's a cheap piece of electronics that someone in their, er, wisdom has decided no longer has the right fashion look. Take audio hifi amplifiers, for example. Visit (in declining order of salubriousness) secondhand stores, garage sales, roadside rubbish collections and the tip and you'll find a host of amplifiers that are available at ridiculous cost (as in, ridiculously low . . .).

Consider, for example, the Rotel 712 integrated stereo amplifier shown on these pages. It cost me just $8.00. Yes, that's right . . . eight bucks. What was wrong with it, you ask? Answer: nothing.

Similar bargains can be had in lots of places. Recently, I bought a Rotel (yep, I like that brand) RX-203 stereo receiver for . . . wait for it . . . $3. So what was wrong with that one? Well, I haven't tested it yet but I'll wager that it also works fine.

Talking about testing, until recently I thought that any meaningful testing of an amplifier needed stuff like oscilloscopes, standalone frequency generators and specialised audio test gear that I didn't even know about. But then, through the advice of three learned men, I saw the light – the amplifier "test light", so to speak. Those three wise men advised me that all I needed was a digital multimeter, my trusty PC, a few cheap resistors . . . and a jug element!

A jug element? It all sounded so crazy that it might just work.

But do the figures really matter? After all, the reason that you buy an audio amplifier is to listen to it. The answer is yes, especially if you've

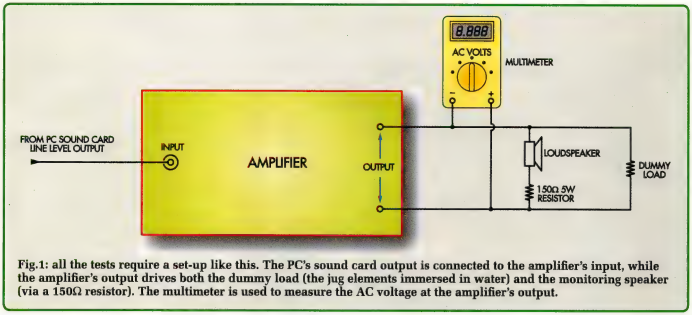


Fig.1: all the tests require a set-up like this. The PC's sound card output is connected to the amplifier's input, while the amplifier's output drives both the dummy load (the jug elements immersed in water) and the monitoring speaker (via a 150Ω resistor). The multimeter is used to measure the AC voltage at the amplifier's output.

heard the distorted sound that some appear people to like.

What's required

The first things that you need for amplifier testing are your ears – both to assess the purity of a quiet test tone and also to listen for any background noise that might exist when there shouldn't be any.

You'll also need a decent digital multimeter. These days "decent" applies down to multimeters costing from about $60, so almost any recent meter will do. It also helps if it can measure frequency in addition to the usual AC volts and resistance. However, that's not vital – it's just a good check.

A cable that connects your PC's sound card output to the amplifier inputs will also be needed. Typically, this will be a cable with a 3mm stereo plug at one end and two RCA plugs at the other.

On the output side of the amplifier, you'll need to connect a monitoring speaker. This will only ever be used at low volumes (no test tones will destroy it), so it can be one of your normal hifi speakers.

To reduce the power into the speaker (so that you won't be deafened), you'll need to connect a 150Ω 5W wirewound resistor in series with it. That will set you back about 30 cents – or nothing if you can salvage one from your junkbox (I got one from an old photocopier).

And now we come to the jug element, or elements. Yes, you'll need one or two electric jug elements (ie, the 240V sort that you can buy at any supermarket) and a Pyrex or high-temperature glass bowl that you can fill with water before suspending the elements within it. If you haven't already guessed, this is our amplifier load – and a beauty it is, too.

Making the load

Turning the jug elements into the load is easy. If you use two (as I did), gradually unwind turns of wire from each element until the remainder left on each ceramic former has a resistance of 16Ω, as measured with your multimeter. Then, when you wire the modified elements in parallel, you'll have a very high power load with a total resistance of 8Ω.

Alternatively, you can make each element 4Ω and then wire them in series for an 8Ω load. It really doesn't matter how you do it – you just want lots of windings and a resistance that matches the load the amplifier expects to see.

This secondhand amplifier – bought for just $8.00 – was the guinea pig for much of the testing described here. Using just simple tools and techniques, its power output, frequency response and signal-to-noise ratio were all measured, along with the response of its tone controls.

The amplifier test load is formed by two slightly modified electric jug elements suspended in a jug of cooling water. This load can sink very large power outputs – if the water starts getting hot, simply swap it for some cold water.

You can also make 2Ω and 4Ω loads, just by modifying the above procedure.

Next, place the elements in that bowl of water and then use heavy-gauge wire to connect the jug elements together and to the amplifier.

Warning: if you are testing a high-power amplifier, this water can become hot enough to burn. Ensure that small children, pets, local religious proselytisers and the like cannot come in contact with it.

Generating the test tones

To generate pure sinewave test tones, you'll need to download some frequency generator software off the web. This is available either free of charge or with a 30-day free trial period. We used PAS Products Frequency Generator version 2.6 (from **www.pas-products.com**) but there are plenty of other programs around – a web search will soon find them.

Practice playing with the generator while monitoring the sound through your normal PC speakers until you are able to do two things: (1) generate sinewave signals over a 20Hz to 20kHz (20,000Hz) range; and (2) vary the volume level. The latter requirement is important – some frequency generators make it difficult to vary the amplitude (volume) of the test tones and so you should check that this function exists.

Measuring power

This one's really exciting – everyone knows about amplifier power and being able to measure the output with your own eyes, hands and ears is great fun. Here's how you do it:

(1). Ensure that the load is covered by water, then connect it to one channel of the amplifier.

(2). Wire the monitoring speaker in parallel with the load – ie, connect it to the same channel. Don't forget that you need to install a 150Ω 5W resistor in series with the feed to this speaker – see Fig.1.

(3). Set your multimeter to "VOLTS AC" and connect it across the same channel.

(4). Connect the line-level output from the sound card to the corresponding input of the amplifier.

(5). Start the frequency generator software on your PC and select a frequency of 1000Hz.

(6). Set the volume control on the frequency generator software to give an amplifier input voltage of 1V (you can measure this at the input to the amplifier). If the sound card's output won't go that high, set it to a lower value that you carefully note.

Fig.1 shows the complete test set-up.

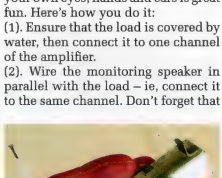
When you turn up the amplifier's volume control (you did remember to switch it on?), you should hear a faint 1000Hz test tone coming from the speaker. At the same time, there should also be an AC voltage level on the multimeter.

If everything is working as it should, turn up the amplifier volume, listening intently to the test sound and watching the changing figures on the multimeter. When the volume reaches a certain point – called "clipping" – the sound from the speaker will suddenly and clearly distort. Take note of the multimeter reading and then quickly turn the volume back down.

On my $8.00 Rotel unit, the lefthand channel yielded a result of 19.6V before clipping. So how do we turn this into a maximum power figure? It's easy – just square the number (ie, multiply it by itself) and then divide that by the resistance of your dummy load. The formula is: $P = V^2/R$.

In this case, we have 19.6 x 19.6 ÷ 8.5 = 45 watts (45W).

I then repeated the test for the other channel and got a figure of 48W. Not bad, eh? My $8.00 amplifier has a bit of punch!



A 150Ω 5W wirewound resistor is wired in series with the loudspeaker so that the test tones can be monitored at full amplifier power. This resistor can be bought off-the-shelf for about 30c or better still, salvaged for nothing from discarded equipment.

Checking frequency response

Now you might be saying that it's great that this amplifier has 45-odd watts per channel, but that's only at 1000Hz. What about over the rest of the frequency range? This introduces the idea of frequency response – just how flat is the response of the amplifier across its frequency range?

Testing this is again very easy and

the set-up is the same as shown in Fig.1.

Leave everything in place as it was for the previous test but wind the wick down to about "2" or "3" on the volume dial (ie, adjust it to what normally would be a quiet listening level). Now decrease the test tone frequency to 20Hz (you will no longer be able to hear it from your speaker – the frequency is too low). Make sure that all the tone controls are set to flat (zero adjustment) and switch off the loudness button.

Next, measure the input voltage to the amplifier – it should be the same as it was for the previous test – ie, 1V (or your nominated figure). If the input voltage has changed, adjust the output of the frequency generator until it is again 1V (or the nominated test figure), then measure the output voltage of the amplifier and note this value.

Next, change the input frequency to 100Hz and adjust the generator until the input signal is the same as for the previous measurement. As before, measure the output voltage from the amplifier and note this value.

Keep doing this right through the frequency range, up to 20,000Hz. Of course, you don't need to do the measurements all in small increments. Table 1 shows the results of this testing on the Rotel amplifier.

As you can see, with a constant input voltage, the highest output from the right channel was 2.2V while the lowest was 2.1V. So it doesn't vary much, does it? But how do we express this variation in that unit beloved of audio engineers – decibels or dB? Again, it's easy: simply divide the highest figure by the lowest, take the logarithm of the result, then multiply by 20.

So, from the table of data:

[log (2.2/2.1)] x 20 = 0.4dB

So between 20 and 20,000Hz the biggest variation away from a ruler flat response for this channel is just 0.4dB. The other channel measured a little worse at 0.5dB. Those are very good specifications for an amplifier – those eight dollars are looking better and better all the time!

Signal-to-noise ratio

The signal-to-noise ratio is a measure of how quiet an amplifier by itself is: for example, when all the sound stops, you shouldn't be able to hear anything – no hiss and no hum. Well, not because of the amplifier, anyway.

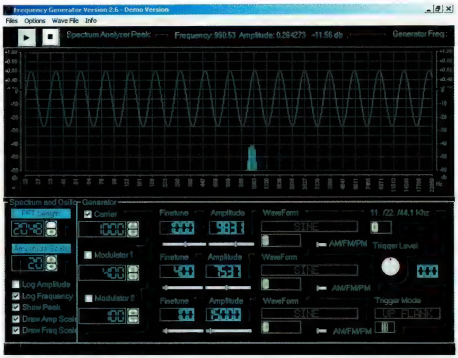


Fig.2: this audio frequency generator software is available for a 30-day free trial period via a web download. Just about any frequency generator software is suitable for the amplifier testing procedure described in this article.

Table 1: Frequency Response Measurements

Frequency	20Hz	100Hz	1kHz	5kHz	10kHz	15kHz	20kHz
R-Channel Output	2.17V	2.15V	2.20V	2.10V	2.10V	2.12V	2.10V
L-Channel Output	2.23V	2.15V	2.12V	2.14V	2.18V	2.10V	2.15V

This table shows the output voltages measured for both the left and right channels at seven different input frequencies. As can be seen, the left channel of the old Rotel amplifier has a slightly wider variation than the right channel. However, simple calculations (see text) show that even this varies by only about 0.5dB. Note: input signal voltage held at a constant 1V.

Remember how when we tested the maximum power output on the Rotel, we achieved a maximum output before clipping of 19.6V? That's one of the figures we need for this test. The other is gathered by again measuring the voltage output with the volume control wound almost fully up but this time with zero signal input.

However, if we simply pull the signal input lead out of the amplifier, it's likely that electrical noise will be picked up from the surroundings. To overcome this, we wire a 1kΩ resistor across the input. As well as preventing noise pickup, this also keeps the amplifier "happy" as it's seeing some input resistance.

Again the dummy load, speaker and multimeter can be left connected as we had them before. Now wind up the volume control to the level at which clipping previously occurred (eg "8" on the knob) and read the no-input-signal output voltage. It will be very low. In the case of the Rotel, it was 2.6mV.

Table 2: Bass Control Response

Frequency	20Hz	50Hz	100Hz
Bass Control Max.	11.1V	9.9V	7.3V
Bass Control Min.	0.40V	0.48V	0.67V

As shown here, the Rotel amplifier's bass control has its maximum effect at just 20Hz. These are the "raw" voltage outputs when the bass control is turned and some simple calculations show the adjustment range to be about ±14dB. Note: input signal held at 1V; output signal is 2.16V with control "flat" (ie, centred).

So at full power, the output was 19.6V (that's 19,600mV) while with no input, the output is 2.6mV at the

Another Secondhand "Bargain" Amplifier

It was another "cheapy" buy although not in the same class as the Rotel covered in the main text. I bought this Bose professional amplifier by tender (so no extensive testing was allowed prior to purchase) for just $480. That's pretty good when the new price is US$2000 and the thing can develop no less than a claimed 450W per channel into 8Ω loads!

Unfortunately, once I'd got it home, I found that my new purchase wouldn't develop any watts into any channels. Instead, it just blew the circuit breaker on the external power board. Inside the case, the transformer was simultaneously getting hot and it proved very expensive to replace.

The replacement fixed the problem and I was ready to do some testing. So how much power output did it deliver? Well, with one channel driven, try 560W into an 8.5Ω load! And that's with no apparent clipping (this amplifier incorporates internal soft clipping circuitry). Its signal-to-noise ratio wasn't as impressive though and measured just 88dB – way below the best of Silicon Chip's designs.

same volume control position. To turn this into the signal-to-noise ratio, we do the same sort of calculation as for frequency response, ie:

[log (19,600/2.6)] x 20 = 77.5dB

Now a 77.5dB signal-to-noise ratio isn't wonderful – in fact, one of the three wise men told me that it's about par for the course for FM radio. But where I'm using this amplifier – with computer fans constantly humming away in the background – I can never hear any noise from the it, anyway. (Well, that's my excuse!)

And that brings us to another simple testing technique. Connect the amplifier to its normal speakers (no resistor needed) and make sure that there is no input signal. That done, turn the volume right up and listen intently to the speakers. The more noise that you can then hear, the poorer the signal-to-noise ratio of the amplifier.

Bass & treble controls

Measuring the action of the bass and treble controls is very similar to measuring the frequency response – except this time you're the one causing the change in the response.

To begin, set the amplifier test system up as for testing frequency response – ie, dummy load, monitoring speaker, constant input signal level, and your multimeter in parallel with the load and speaker. Most bass and treble controls are centred around 100Hz and 5000Hz respectively, so start testing with those frequencies.

As an example, let's look at the action of the bass control. With a 100Hz input signal (say at 1V level), the output might be 2.16V with the bass control flat, 7.3V with it at maximum, and 0.67V with it at minimum. Note these figures, then repeat the procedure for 50Hz and 20Hz input signals.

Table 2 shows the results for my Rotel amplifier. This reveals that the maximum effect of the bass control is at 20Hz – an unusually low frequency. It also shows that it can boost the signal output from a "flat" 2.16V level to 11.1V, or reduce it to just 0.4V.

Expressing these as dB figures uses the same old equation:

[log (11.1/2.16)] x 20 = 14dB gain

Similarly, the bass cut was almost symmetrical at 14-15dB, while the treble (centred around a high 15kHz) proved to be ±12dB.

Conclusion

It's possible to gain a lot of information about the performance of an audio amplifier with very little effort and just a few basic test tools.

Give it a go some time – you'll quickly find out just how good (or bad) that bargain really is.

Footnote: my thanks to the three wise men: Leo, John and Bob. SC

Important Points To Note

(1) The frequency response tests in this article assume that the digital multimeter has a frequency response up to at least 20kHz. Many DMMs are not this good and may have a frequency not much in excess of 1kHz. Such meters can be used for the power test at 1kHz but not the frequency response or treble control checks.

(2) When doing power output tests on valve stereo amplifiers, both channel outputs must have dummy loads. **Operating a valve amplifier without a load may cause serious damage.**

(3) The power tests in this article are equivalent to the continuous (RMS) power output of an amplifier, even though they are carried out for a short duration. Running an amplifier continuously under these conditions may cause damage.

(4) If you want to experiment further with Internet software for audio testing, including having your PC operate as an audio oscilloscope, refer to "Digital Instrumentation Software For Your PC" and "Sound Card Interface For PC Test Instruments". Both these articles were published in the August 2002 issue of Silicon Chip.

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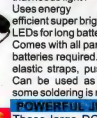

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SC_MAY_04

Component video to RGB converter

Want the best possible picture quality from your DVD player? The component video outputs are the ones to use. But what if your TV can only accept "RGB" video signals? This easy-to-build converter solves the problem, with no discernible picture degradation.

By JIM ROWE

THE PICTURE AND sound quality available from DVD video discs is streets ahead of what's available from VHS tapes. That's no doubt why sales of DVD players, widescreen TVs and surround sound systems have rocketed ahead in the last couple of years. DVDs have also generated tremendous interest in setting up home theatres, so enthusiasts can watch movies at home with a presentation almost as good as that in their local cinema.

At the same time, the very high picture and sound quality available from the best movie DVDs has raised consumer expectations. And it has motivated enthusiasts to find out how they can achieve the best possible results from their home theatre set-ups.

For example, most people are now aware that the highest picture quality from a DVD can be achieved only by using a player fitted with "component video" outputs, connected in turn to the corresponding inputs of a widescreen TV or video projector. This is because the video is actually recorded on DVDs in digital component format, so component video output signals have undergone less processing than those from S-video or composite video outputs.

As a result, component video signals provide cleaner and sharper pictures than the other signal formats. However, some widescreen TVs (particularly those of European

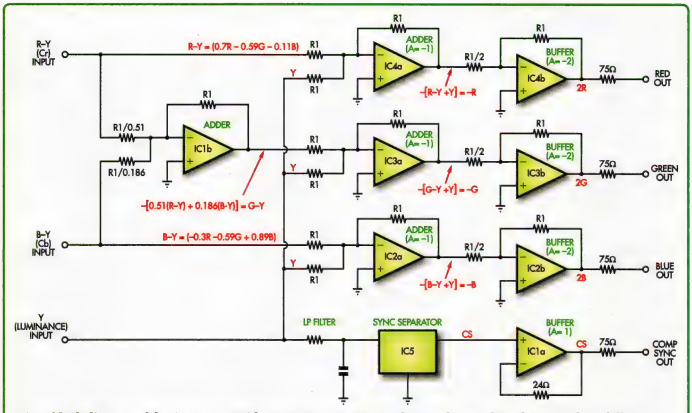


Fig.1: block diagram of the Component Video To RGB Converter. IC1b is used to produce the G-Y colour difference signal, while IC2a, IC3a & IC4a produce inverted RGB signals which are then buffered and fed to the outputs.

origin) and some projectors don't have component video inputs. Instead, they may be fitted with "RGB" (red, green, blue) video inputs, made either via RCA connectors or a European-style SCART connector – these in addition to the usual composite video and S-video inputs

And that's where problems can arise – RGB inputs are not compatible with component video signals (and most DVD players don't have RGB outputs). This means that you need a converter box to change the signal format if you want to drive your TV's RGB inputs from the component video outputs on your DVD player.

And that's exactly what this low-cost project is designed to do. As shown in the photos, it's housed in a small instrument case and has three RCA sockets on the front panel to accept component video signals from a DVD player. The circuitry inside then processes these signals to produce the corresponding RGB video and sync signals, which are provided via four RCA sockets on the rear panel.

These output signals can then be fed to the RGB video inputs of a TV set or video projector, either via RCA-to-RCA cables or via a SCART adaptor cable if necessary.

The complete converter is easy to build and runs from a 9V AC plug-pack supply, drawing less than 150mA (1.3W).

How it works

To understand how the converter works, you need to know that the component video format used on DVDs consists of three video signals or "components". These are the "Y" or luminance signal and two other signals called "R-Y" (or "Cr" or "Pr") and "B-Y" (or "Cb" or "Pb"). The Y signal is basically the high-bandwidth black and white picture information, while the R-Y and B-Y signals are described as the **colour difference** signals (these have a lower bandwidth than the Y signal).

As the R-Y and B-Y labels suggest, these two colour difference signals actually correspond to the red (R) and blue (B) colour signals from the colour TV camera (or film scanner) that's used to produce the video signals in the first place, but with the Y luminance signal subtracted from them.

The RGB output signals are accessible via RCA sockets at the rear of the unit, along with a composite sync output signal (see text). Also accessible from the rear is the power socket.

Parts List

1 PC board, code 02105041, 117 x 102mm (double sided)
1 plastic instrument case, 140 x 110 x 35mm
7 RCA sockets, 90° PC-mount (2 red, 2 black, 1 yellow, 1 green, 1 white)
1 2.5mm concentric power socket, PC-mount
8 4G x 6mm self-tapping screws
2 M3 x 6mm machine screws with nuts & lock washers
4 stick-on rubber feet

Semiconductors

4 MAX4451ESA dual wideband op amps, SOIC-8 (IC1-IC4)
1 LM1881 video sync separator (IC5)
1 7805 +5V regulator (REG1)
1 7905 -5V regulator (REG2)
1 3mm green LED (LED1)
2 1N4004 diodes (D1,D2)

Capacitors

2 2200µF 16V or 25V RB electrolytic
2 100µF 10V RB electrolytic
2 10µF tantalum
2 2.2µF tantalum
9 100nF multilayer monolithic
2 100nF MKT polyester
1 470pF disc ceramic

Resistors (0.25W, 1%)

1 680kΩ	1 510Ω
1 7.5kΩ	1 470Ω
1 4.3kΩ	1 180Ω
1 3.6kΩ	1 100Ω
1 2.7kΩ	1 91Ω
1 1kΩ	4 75Ω
1 620Ω	1 24Ω

If you're wondering where the green or "G" colour signal is hiding, it's inside the Y signal. That's because the Y signal is itself produced by processing or "matrixing" the three original colour camera signals, according to this standard formula:

(1). Y = 0.3R + 0.59G + 0.11B

So a more expanded way of expressing the R-Y and B-Y signals is:

(2). R-Y = 0.7R - 0.59G - 0.11B
(3). B-Y = -0.3R - 0.59G + 0.89B

Now since the two colour difference component signals simply consist of the Y "mixture" signal subtracted from the original R and B signals, it's not very difficult to convert them back again. All that needs to be done is to add the Y signal to them again; ie:

(4). R-Y + Y = R
(5). B-Y + Y = B

It's slightly harder to restore the original green signal, because this involves two steps. First we have to recreate the G-Y signal and this is done by dematrixing the R-Y and B-Y signals according to this expression:

(6). -(0.51(R-Y) + 0.186(B-Y)) = G-Y

You can check this out for yourself by expanding the lefthand side using the full expressions for R-Y and B-Y given in equations (2) and (3). The G signal can then be recovered by adding in the Y signal, as follows:

(7). G-Y + Y = G

Block diagram

Just how we do all of this is shown in the block diagram of Fig.1.

The first step is to reconstruct the G-Y signal, by combining 0.51 of the R-Y signal with 0.186 of the B-Y signal. This is done using a wideband inverting adder stage based on IC1b. We now have all three colour difference signals (the other two are fed in directly from the DVD player), so these are then added to the Y luminance signal using inverting adder stages IC4a, IC3a and IC2a.

The outputs of these stages are thus inverted versions of the R, G and B colour signals, so all we have to do after that is pass each one through an inverting output buffer. These output buffers – IC4b, IC3b & IC2b – then drive 75Ω video cables and the 75Ω inputs of a TV receiver (or video projector).

Note that each output buffer stage has a 75Ω "back termination" resistor in series with the output. Because of this, each buffer is given a voltage gain of two (+6dB), to compensate for the 6dB loss that is introduced by these resistors.

But why does the converter also have a sync separator stage using IC5? Well, we've included this because there's some variation in the way TVs and video projectors with RGB inputs handle the video sync signal. Some extract the sync signal from the green (G) video signal, a technique known as "sync out of green", while others expect to receive the video sync signal via a separate composite sync (CS) input line.

The green output from the converter automatically contains the sync signals (as do the red and blue signals), so there's no trouble driving a set with "sync out of green" circuitry. However, so that you can also drive a set which needs separate composite sync, we've included the sync separator as well.

This is derived by first feeding the Y signal to a low-pass filter to remove the colour information. The signal is then fed to a sync separator stage based on IC5 and the CS output from this stage then fed through unity gain buffer stage IC1a, so that the sync signal can be fed along a 75Ω cable.

Circuit details

If you've followed the description so far from the block diagram, you shouldn't have any problems following the full circuit – see Fig.2. As shown, all the video adder and output buffer stages are designed around MAX4451ESA dual wideband (210MHz) op amp ICs from Maxim Integrated Products.

Despite its low cost, the MAX4451 is a very impressive device. Each of its two op amps has a -3dB bandwidth of 210MHz, a gain flat to 55MHz within 0.1dB, and an output slew rate of 485V/µs. This is in a device which comes in an 8-lead SOIC package, and draws a quiescent current of just 6.5mA per amplifier from a ±5V supply. In short, it is ideal for this type of video processing circuit.

The nominal resistor value shown as R1 in the block diagram becomes 510Ω in the full circuit, so this is the value of most of the resistors in the converter. The main resistors with different values are the input resistors for IC1b – which are values chosen to give the correct fractions of R-Y and B-Y to reconstruct G-Y – and the load resistors for the R-Y, Y and B-Y inputs. These may seem to have rather strange values but they've been chosen to bring each input resistance as close as possible to 75Ω (for good cable termination) while allowing for the inputs of the various adder circuits.

The back termination resistors for each of the four converter outputs are of course 75Ω, as shown in the block diagram. Note that although sync output buffer IC1a is a unity gain "voltage follower", the MAX4451 requires a 24Ω resistor in series with the link back to the negative input to ensure stability.

The low-pass filter that's used to remove the colour information (prior to the sync separator stage) consists of

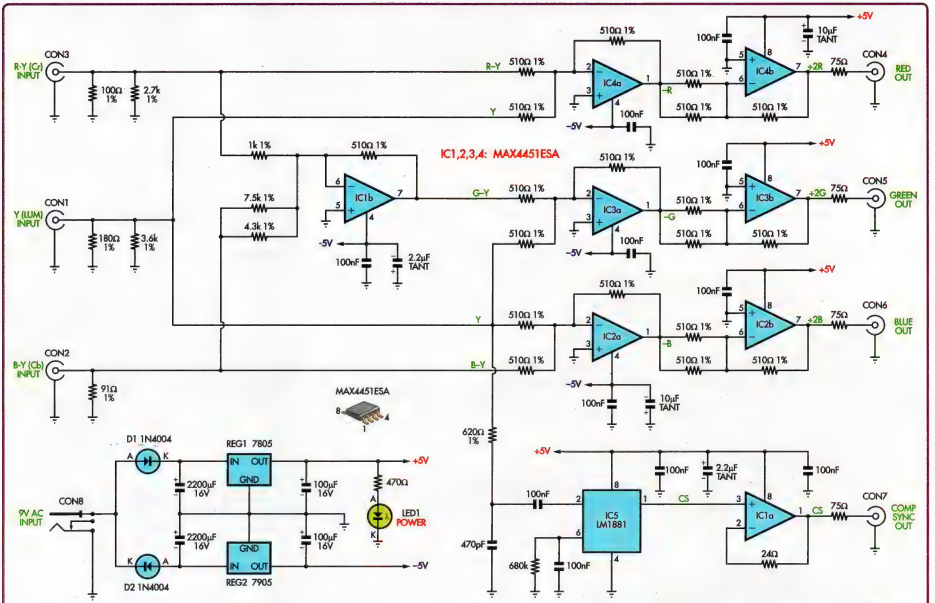


Fig.2: the complete circuit if the Component Video To RGB Converter. The video adder and output buffer stages are all based on MAX4451 dual wideband op amps, while an LM1881 sync separator is used to provide the sync output (via buffer IC1a).

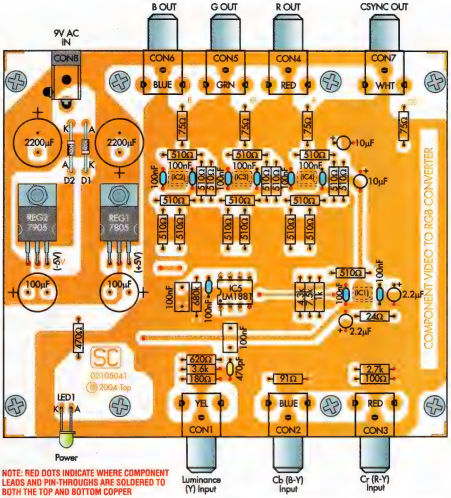


Fig.3: install the parts on the top of the PC board as shown here. The red dots indicate where component leads and "pin-throughs" have to be soldered on both sides of the board.

a 620Ω resistor and 470pF capacitor. From there, the signal is fed to pin 2 of the sync separator (IC5) via a 100nF capacitor. A standard LM1881 device is used for the sync separator and its output at pin 1 is fed to pin 3 of the unity-gain output buffer (IC1a).

Power supply

All the MAX4451 amplifiers run from +5V and -5V, while the LM1881 also runs from +5V. This allows the converter to be operated from a very simple power supply.

As shown, this supply uses an external 9V AC plugpack and this feeds two half-wave rectifiers (D1 & D2) and two 2200µF capacitors to give ±13.5V DC rails. Regulators REG1 and REG2 are then used to provide stable ±5V rails for the converter circuitry. In addition, the +5V rail is used to power the green pilot LED via a 470Ω current-limiting resistor.

Construction

All the video converter circuitry is built on a double-sided PC board coded 02105041 and measuring 117 x 102mm. This in turn is housed in a small instrument case measuring 140 x 110 x 35mm, to produce a very compact and neat unit.

There's no off-board wiring at all, because all the input and output connectors are mounted directly on the PC board along the front and rear edges. As a result, they are all accessed through holes in the front and rear panels, when the case is assembled.

Note, however, that although the PC board is double-sided, the board supplied in kits will probably not have plated-through holes (unless one of the kit suppliers decides to provide it in this more expensive form). As a result, you'll need to solder many of the component leads to the copper on the top of the board, as well as underneath. You'll also need to solder short lengths of tinned copper wire (such as resistor lead offcuts) through a small

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	680kΩ	blue grey yellow brown	blue grey black orange brown
❑	1	7.5kΩ	violet green red brown	violet green black brown brown
❑	1	4.3kΩ	yellow orange red brown	yellow orange black brown brown
❑	1	3.6kΩ	orange blue red brown	orange blue black brown brown
❑	1	2.7kΩ	red violet red brown	red violet black brown brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	1	620Ω	blue red brown brown	blue red black black brown
❑	19	510Ω	green brown brown brown	green brown black black brown
❑	1	470Ω	yellow violet brown brown	yellow violet black black brown
❑	1	180Ω	brown grey brown brown	brown grey black black brown
❑	1	100Ω	brown black brown brown	brown black black black brown
❑	1	91Ω	white brown black brown	white brown black gold brown
❑	4	75Ω	violet green black brown	violet green black gold brown
❑	1	24Ω	red yellow black brown	red yellow black gold brown

Will It Work Backwards?

Can this circuit be made to work backwards – ie, convert RGB video to component video?

Unfortunately, the answer to this question is "no". RGB to component video conversion requires a PAL encoding circuit, which is much more complicated than the relatively simple unit described here.

number of "via" holes, to make connections between some of the top and bottom tracks.

These points are all indicated on the "top-side" PC board overlay diagram (Fig.3) with red dots.

As shown in Fig.3, most of the components fit on the top of the board in the usual way. The only exceptions are the four MAX4451ESA broadband op amps (IC1-IC4), which are in surface-mount SOIC packages and must be mounted on the bottom of the board.

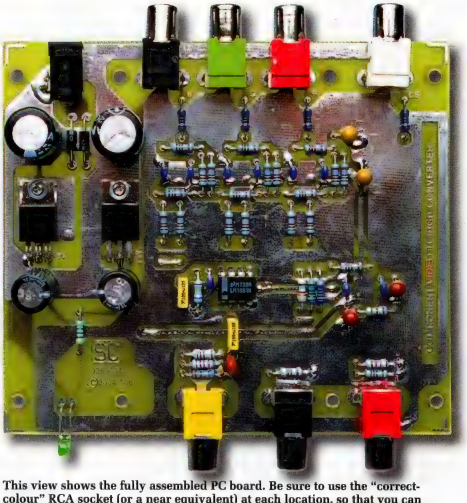
Begin the board assembly by fitting the short wire links which form "vias" between some of the top and bottom copper tracks. There are only five of these, all in the central area of the board around IC5. Fitting these first will ensure you don't forget them!

Next, fit the resistors, making sure you solder their "earthy" leads on both sides of the board where indicated. That done, install the RCA sockets and the 9V AC input socket, using a small drill to enlarge their mounting holes if necessary.

The small monolithic and MKT capacitors, plus the solitary 470pF disc ceramic, can go in next, followed by the four TAG tantalum capacitors and the larger electrolytics. Make sure that the polarised components are all orientated correctly, as shown on Fig.3, and don't forget to solder their leads to the top copper as well where this is indicated.

Next, fit the two diodes in the power supply (D1 & D2), again watching their polarity. Follow these with the two regulators, making sure that you fit each one in the correct position. REG2 is the 7905 and goes on the lefthand side; REG1 is the 7805 and mounts to the right of REG2.

Note that both regulators are mounted horizontally on the top of the board, with all three leads bent downwards



This view shows the fully assembled PC board. Be sure to use the "correct-colour" RCA socket (or a near equivalent) at each location, so that you can easily identify their functions.

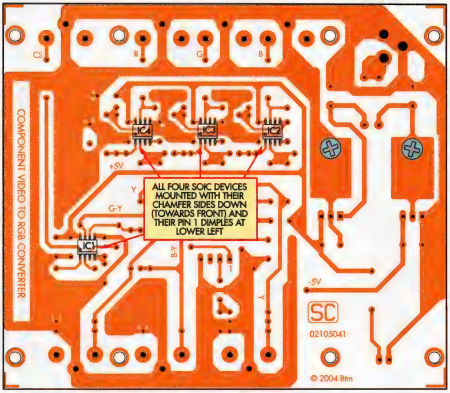
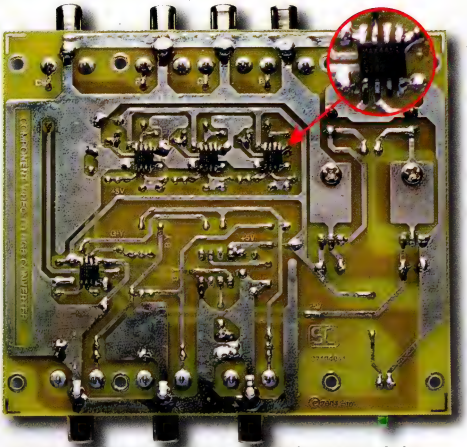


Fig.4: the four MAX4451 dual op amps are soldered to the underside of the PC board as shown here. Make sure you install them the correct way around.



Use a fine-tipped soldering iron when installing the four MAX4451 dual op amps on the underside of the board. Once they're in, check your work carefully using a magnifying glass, to ensure there are no solder bridges.

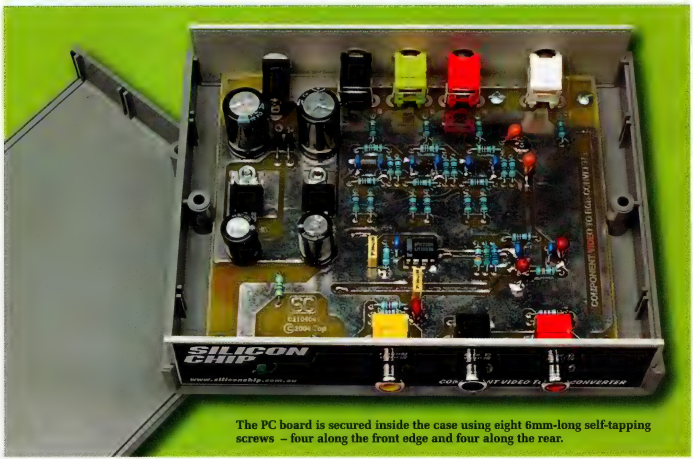
5mm from the body so that they pass down through the board holes. Their device tabs are then fastened against the board's top copper using 6mm x M3 machine screws and nuts.

Once the regulators have been fitted, the next step is to install IC5, the LM1881 sync separator chip. This comes in an 8-pin DIL package and mounts on the top of the board in the usual way. Take care with its orientation, though, and note that its earth pin (pin 4) is soldered to the copper on the top of the board as well as underneath.

Fitting the surface-mount ICs

You should now be ready to fit the four surface-mount ICs (IC1-IC4), which are the only parts mounted under the board. These are in an 8-lead SOIC package, with 1.25mm lead spacing – so they're not too small for manual handling and soldering, provided you're careful and use a soldering iron with a fine-tipped bit.

To fit these ICs, invert the board and find the four mounting locations using the underside diagram as a guide – see Fig.4. You'll find two sets of four small



The PC board is secured inside the case using eight 6mm-long self-tapping screws – four along the front edge and four along the rear.

rectangular pads in each position. That done, remove the four devices from their packaging and examine each one with a magnifying glass so that you can identify the small chamfer along one side – this is used to identify pins 1-4 of the device.

All four devices are mounted on the board with this chamfered side towards the front – ie, downwards in Fig.4.

Each device is installed by first placing it on its set of pads (with the correct orientation) and holding it there using a vacuum pick-up tool or toothpick while you press down gently on one of its eight leads with the tip of your soldering iron. This will usually make a weak solder joint between the lead and the tinning on the board copper – enough to hold the device in place while you solder the rest of its leads to their pads. That done, you can then go back and solder the first lead properly, to complete the job.

Completing the PC board

The final component to fit is the power LED (LED1). This fits from the top of the board, with its longer anode lead towards the right (ie, towards CON1). Solder the leads in place with the body of the LED about 17mm above the top of the board (a strip of cardboard makes a handy spacer).

Bend both leads down together at right angles after soldering, at a point 9mm above the board (ie, 8mm from the LED body). The LED will then be pointing forward horizontally, ready to protrude through the matching hole in the front panel when it is fitted.

Drilling the panels

At this stage, your converter board assembly should be complete, so place it aside while you prepare the front and rear panels of the case. These each involve drilling and reaming a small number of holes for the various connectors and the LED, using a photocopy of the panel artwork as a drilling guide.

Additional photocopies of the artworks can then be cut out and attached to the outside of each panel, to make them look professional, as on the prototype.

The way to do this is to first make a copy of the artwork on adhesive-backed "A4 label sheet" paper. The labels are then trimmed, peeled off the backing and attached to the panels. A length of clear packaging tape (ie, wide adhesive tape) is then applied over each panel, to protect it from dirt and finger grease.

Finally, the excess tape can be trimmed off around the panels and the holes cut out using a sharp hobby knife.

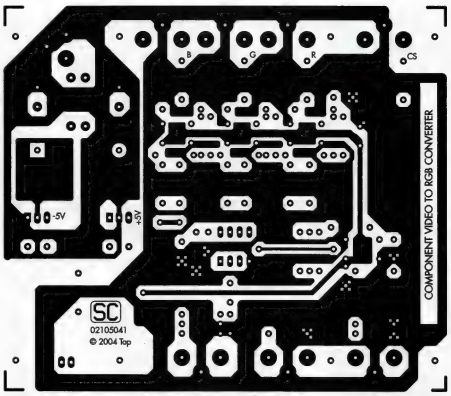


Fig.5: this is the full-size etching pattern for the top side of the PC board.

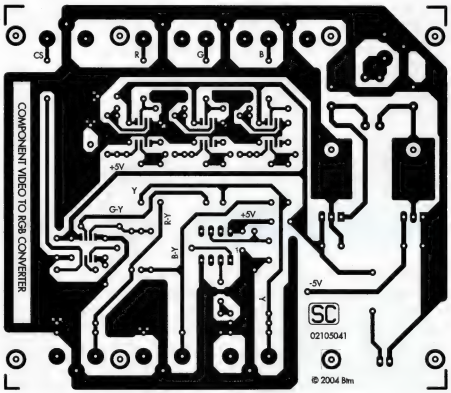


Fig.6: the full-size etching pattern for the bottom of the PC board. Check both sides of the PC board for etching defects before installing any parts.

Fig.7: these full-size artworks can be used as drilling templates for the front and rear panels.

Of course, if you buy a complete kit, you probably won't have to do any of this. Instead, the panels will most likely be supplied pre-punched and with screened lettering for a really professional finish.

Now for the final assembly. This is done by first fitting the panels over the connectors on each side of the board (and over the LED in the case of the front panel) and then lowering this assembly into the bottom half of the case – ie, by sliding each panel into its mating slot. It's then simply a matter of fitting eight small 6mm long self-tapping screws (four along the front edge and four along the rear) to hold the PC board in place.

Finally, the top half of the case can be fitted and secured from the bottom using the two long countersink-head self-tappers provided.

Your Component Video To RGB Converter should now be complete and ready for use. There are no adjustments to make – all you have to do is connect a suitable 9V AC plugpack and it should spring to life.

Troubleshooting

If it doesn't work, the first step is to go back over your work and check that all components are correctly positioned and orientated. Check also for missed solder joints, especially where leads have to be soldered on both sides of the PC board.

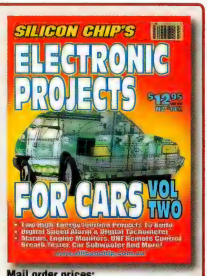
Next, check the power supply rails. There should be +5V at the output of REG1 and -5V at the output of REG2. If you don't get this, check the two regulators and diodes D1 and D2.

You should also be able to measure +5V (with respect to ground) on pin 8 of all ICs and -5V on pin 4 of IC1-IC4.

Finally, if LED1 fails to light and the +5V rail is correct, check that the LED has been installed correctly. Check also that its 470Ω current limiting resistor is correct. **SC**

SILICON CHIP
Car Projects, Volume 2

THE PROJECTS: High-Energy Universal Ignition System; High-Energy Multispark CDI System; Programmable Ignition Timing Module; Digital Speed Alarm & Speedometer; Digital Tachometer With LED Display; Digital Voltmeter (12V or 24V); Blocked Filter Alarm; Simple Mixture Display For Fuel-Injected Cars; Motorbike Alarm; Headlight Reminder; Engine Immobiliser Mk.2; Engine Rev Limiter; 4-Channel UHF Remote Control; LED Lighting For Cars; The Booze Buster Breath Tester; Little Dynamite Subwoofer; Neon Tube Modulator.



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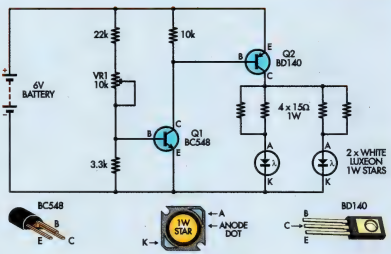
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Exit sign with battery protection

This circuit substitutes two white Luxeon 1W Star LEDs for the inverter and fluorescent tube in a standard battery-backed illuminated exit sign, as used in commercial premises. While the Luxeons have less light output than a standard small fluorescent tube, their directional light is quite adequate for the purpose and they do result in less current drain from the battery.

However, the use of a 6V SLA battery for this application means that it can be completely discharged if the 240VAC mains supply is absent for a long period, as can happen when the power to vacant premises is switched off. Such a complete discharge will effectively destroy the battery and must be avoided. This circuit achieves this by switching off Q1 & Q2 when the battery voltage falls below 5.5V, as set by trimpot VR1. For voltages below 5V, the current drain falls to below 200µA.

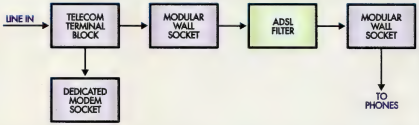


Brad Sheargold,
Collaroy, NSW. ($30)

One ADSL filter serves several phones

In a typical broadband ADSL internet installation, an ADSL filter is required for each telephone or fax machine. This can be an expensive proposition for a home with four or more phones.

This method avoids the need for separate filters by having one filter installed in the fixed phone wiring. A typical installation requires a separate filter for each phone and three filters is the recommended maximum, set by Telstra's limit of the ringer equivalent number (REN) of three allowed on a line.



The normal solution to this is to install a splitter and an amplifier at a cost of $170 -$200. This method involves splitting the line as it comes in, having a dedicated socket for the modem and then running all the phones via the one filter. The filters have RJ 12 sockets at each side so the setup can be run with suitable cables and modular wall sockets.

Julian James,
Coledale, NSW. ($25).

CONTRIBUTE AND WIN!

As you can see, we pay good money for each of the "Circuit Notebook" contributions published in SILICON CHIP. But there's an even better reason to send in your circuit idea: each month, the best contribution published will win a superb Peak Atlas LCR Meter valued at $195.00.

So don't keep that brilliant circuit secret any more: sketch it out, write a brief description and send it to SILICON CHIP and you could be a winner!

PICAXE home security project

This home security project is based on a PICAXE-08 which monitors two infrared light beams, at the top and bottom of a flight of stairs. At the bottom of the stairs, an IR transmitter diode is mounted in the stair column and an IR receiver (sensor A) is installed in its opposite number. Therefore the 38kHz modulated IR beam is broken when a person enters the flight of stairs. A similar arrangement is installed at the top of the stairs (sensor B).

An LDR (light dependent resistor) determines whether it's day or night (ADC numbers) and the program then changes the action of both IR sensors. When a person comes up the stairs during the day, sensor A triggers two wireless remote door bells, one in the house and one in the back shed via a relay, while sensor B is inactive.

A person going down the stairs in daylight triggers sensor B to put a 20-second hold on sensor A so that the bells don't ring. At night, a person going up the stairs triggers sensor A to cause the bells to sound as well as switching on two floodlights to illuminate the front of the house for three minutes. When the B sensor beam is broken by a person going down the stairs at night, the floodlights come on again for three minutes and the doorbell is again inhibited for 20 seconds.

There are two other optional input devices: a pushbutton switch inside the house and an LDR circuit that detects car headlights coming up the driveway. The pushbutton will not ring the bell unless the headlight monitor is triggered. Both turn on the floodlights. The circuit works as follows:

IC1 is a 555 timer configured as an astable oscillator operating at around 38kHz to drive both IR diodes via 150Ω resistors. When either sensor A's or B's beam is broken, its respective IR receiver (IRRX1,2) goes high. The respective PICAXE input pin 3 or 4 is also pulled high via diodes D1 or D2.

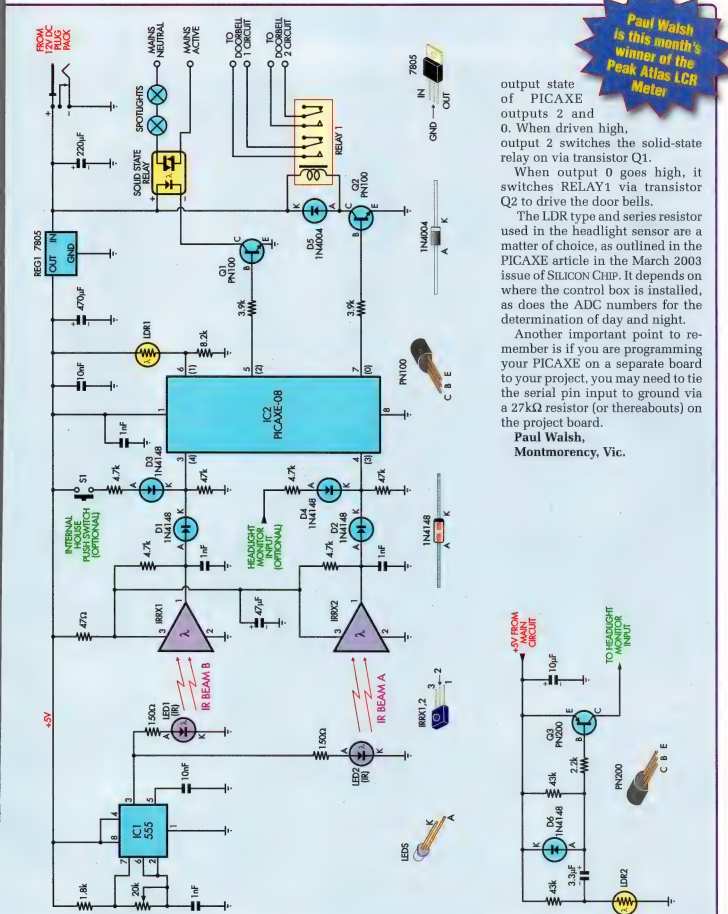
These input pins can also be pulled high by pushbutton switch S1 or the headlight sensor, via their respective diodes (D3 or D4) and 4.7kΩ resistors. In fact, D1 & D3 and D2 & D4 and their respective 4.7kΩ resistors comprise OR gates to control the PICAXE inputs.

The program determines the

continued next page

PROGRAM LISTING

```
main:
Readadc 1,b0
if b0 >75 then daylight
if b0 <=75 then night

daylight:
low 2                          'output 2 is light
low 0                          'output 0 is bell
if pin3 = 1 then bell          'pin3 is A bottom/car headlight sensor
if pin4 = 1 then break         'pin4 is B top/push button sensor
goto main

night:
low2
low 0
if pin3 = 1 then both          'bell & light
if pin4 = 1 then light
goto main

both:
high 2                         'turn on light & ring doorbell at night
high 0
pause 1000                     '1 sec pause to allow relay on
low 0
wait 60                        'keep light on for 3min
wait 60
wait 60
low 2
goto main

break:                         'pauses doorbell in day-lets you walk
wait 20                        'downstairs without triggering doorbell
goto main

bell:                          'ring doorbell in day
high 0
pause 1000                     'relay on 1 second
low 0
goto main

light:                         'light on at night, pause doorbell
high 2                         'to walk down without triggering doorbell
wait 60
wait 60
wait 60
low 2
goto main
```



Paul Walsh is this month's winner of the Peak Atlas LCR Meter

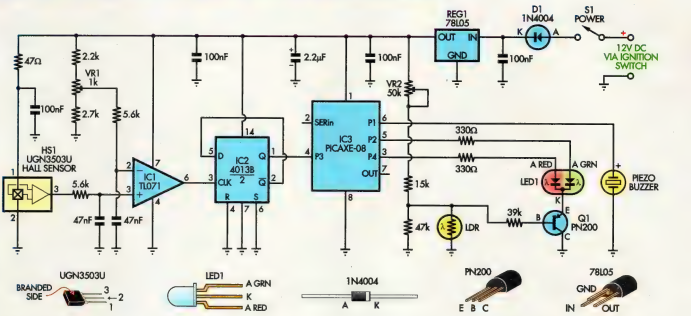
output state of PICAXE outputs 2 and 0. When driven high, output 2 switches the solid-state relay on via transistor Q1.

When output 0 goes high, it switches RELAY1 via transistor Q2 to drive the door bells.

The LDR type and series resistor used in the headlight sensor are a matter of choice, as outlined in the PICAXE article in the March 2003 issue of SILICON CHIP. It depends on where the control box is installed, as does the ADC numbers for the determination of day and night.

Another important point to remember is if you are programming your PICAXE on a separate board to your project, you may need to tie the serial pin input to ground via a 27kΩ resistor (or thereabouts) on the project board.

Paul Walsh,
Montmorency, Vic.



PICAXE-based car speed alarm

This circuit monitors the speed of a vehicle using a Hall Effect sensor and magnets attached to a drive-shaft or half shaft, (as described in the Digital Speed Alarm for Cars, November & December 1999).

When the magnets go past the Hall sensor, an input signal is fed to IC1 which is a TL071 op amp connected as a comparator. Trimpot VR1 sets the threshold and the output signal is a square wave fed to one half of a 4013 D-type flip-flop, IC2.

The output of IC2 equates to half a revolution of the wheel, assuming the Hall Sensor is monitoring a vehicle's half shaft.

The PICAXE-08 (IC3) measures the pulse width in milliseconds. It does this four times which equates to four revolutions of the wheel. IC3 stores that information in a memory location. This stored value has a direct relation to the speed of the car. After that, it just keeps comparing the next four readings with the first value stored.

If the value is higher, the car is going slower. If lower, the car is going faster. Therefore, it turns on the green or red LED. It also calculates the 5% over-speed value which turns on the piezo buzzer.

VR2, the LDR and transistor Q1 control the brightness of the LEDs, to suit the ambient light.

To set the speed, turn the unit on (via S1) when the vehicle is doing the desired speed. For a different speed, switch the unit off and then back on again when the desired speed is reached.

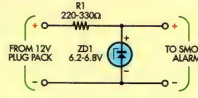
Power for the circuit comes from the vehicle's battery via the ignition switch. Diode D1 provides reverse polarity protection, while REG1 provides a stable 5V supply for the ICs.

Henri W. Klok,
Algester, Qld. ($50)

Low-cost low-intensity alarm

Ever needed an alarm to monitor something but you didn't want to annoy the neighbours or scare the hell out of the family in the middle of the night?

Using a feature found in most smoke alarms these days, this little circuit may do the trick for you. When the 9V battery level drops to about 7.4V in most smoke alarms, they emit a brief chirp at around 40 second intervals. In most cases,



this is enough to attract attention, without the likelihood of waking the whole household.

In effect, this circuit simply powers the smoke alarm at 6.8V, as derived from a zener diode (ZD1), so that it sounds its low battery warning. Apart from the zener diode, the smoke alarm draws only a few microamps, with a brief current spike during the "chirp".

Smoke alarms are now very cheap to buy so this is a good alternative to a piezo siren.

More information on a common Smoke Alarm chip made by Motorola can be obtained at:

http://e-www.motorola.com/files/sensors/doc/data_sheet/MC14467-1.pdf

Michael Jeffery,
Eurobin, Vic. ($25)

PROGRAM LISTING

```
'w2    'get speed reading
'w3    'store speed setting
'w4    'compare speed value

       'start program

for b0 = 1 to 4                 'time to settle
high 2                          'after switch on
pause 100                       'green led flashing
low 2
pause 100
next

       'get speed setting

again:
w3 = 0
for b0 = 1 to 4                                 'take four readings
pulsin 3,1,w2
if w2 >15800 then again                         'prevent over run in w3
w3 = w3 + w2                                    'store speed setting

next

       'start to compare speed

chkspd:
w4 = 0
for b0 = 1 to 4                                 'again four readings
pulsin 3,1,w2
if w2 = 0 or w2 > 15800 then error              'speed below range
w4 = w4 +w2                                     'actual speed reading
next

if w4 > w3 then green       'below speed
if w4 < w3 then red         'overspeed

red:
w5 = w3/20
w5 = w3 – w5                '5% of speed limit
if w4 < w5 then alarm
high 4                      'just over speed
go to chkspd

error: for b0 = 1 to 4
alarm:
high 1                      '5% more over       pause 500
high4                       'speed limit        HIGH 2
low 2                                           Pause 500
pause 100                                       Low 2
low 1                                           next
w5 = 0                                          w2 = 0
goto chkspd                 'check again        goto chkspd

green:
high 2                      'turn on green
low 4                       'turn off red
w5 = 0
goto chkspd                 'check again
```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Using a Rabbit isn't rocket science... or is it?

~~FLY~~ RUN, RABBIT, ~~FLY~~ RUN

Remember the RABBIT RCM2100 microprocessor module we introduced to SILICON CHIP readers back in October 2001? Seems lately its brother, the RCM2300, has been soaring to new heights . . .

The Amateur Spaceflight Association (ASA) of Houston, Texas has a mission:

"Promote space-related activities in such a manner that safely challenges the technical limits of amateur space flight."

Breaking the world record for amateur rocket altitude would help accomplish this goal but the ASA needs more than a bottle of liquid oxygen, a box of matches and a really long ruler.

Given a payload of opportunity, Nicolaus Radford, Chief Avionics Engineer for ASA, went ballistic with the Rabbit RCM2300 Microprocessor Core Module.

"I got into Rabbit about 3½ years ago, basically just looking for an embedded processor that would fit the form factor and capability I was after. I came across the Rabbit Semiconductor web site, bought one and haven't looked back since," he said.

The ASA's most recent rocket launch was about 5.6m in length and 230mm in diameter. It pulled about 8.5G on takeoff, broke the sound barrier and flew up to about 3500m. The rocket had video, telemetry, GPS and full dynamical analysis of the rocket, all in real time.

To measure all vehicle parameters, including acceleration, velocity, pressure and position, they built a custom data acquisition board that had all the components on it.

It used the Rabbit and an I^2C bus to read and store data in the Rabbit's flash memory. At the same time, the Rabbit was also serially interfacing to a terminal node controller and a GPS unit on two serial ports.

The Rabbit ran on the I^2C bus and read all the different sensors around the rocket, then formatted the data and sent it to the terminal node controller. This in turn formatted the data for packet radio and transmitted it on an amateur radio frequency. GPS readings were also being sent via a telemetry band to the ground.

According to Radford, it was very simple to string up multiple I^2C controllers and talk to them to get all the data back. "It was great because on a long rocket you have sensors in the nose cone and the body and it was nice to interface with these sensors with two wires instead of a string of wires. We used two of the four serial ports on the Rabbit to interface to a terminal node controller, which interfaced to an amateur radio. We also interfaced to a GPS receiver."

"When you look at how small the RCM2300 is compared to what it does, I don't think there is anything

Getting an 18.5ft rocket ready for launch is not quite as simple as placing it in a large bottle and lighting a long wick! Some idea of the size of the craft can be gleaned from these two photos, courtesy of ASA.

on the market that can beat it. You've got 40 I/O pins, four serial ports, flash memory to store data – you don't need any external interface to it to run our system except the core module. The size and space saving is just tremendous for the capability. And it has got relatively low power consumption –110mA at 5V is pretty small!"

Critical components of Dynamic C helped Radford get to the launch pad. "We probably could not have done the project in the timeframe and ease that we did if we didn't have the costate construct. It was just phenomenally easy to use. It basically simulates a multi-threaded environment with hardly any overhead whatsoever. The way Dynamic C time-slices and the way the event control is set up is just amazing. If you were to try to write out and code out to simulate a multi-thread yourself, you would be bogged down in months of coding. I don't think as a programmer I could make a better utilisation of processing time than what the Rabbit did using the costatement. And I have yet to see this anywhere else."

Front view of the payload/electronics section of the rocket (red section at top).

The development time to completely get the system up and running was eight months.

"Had we not had the development kit and protoboard to easily interface the programming pins of the Rabbit, had we used some other processor where we would continuously have to fabricate our own ways to interface to the processor, it wouldn't have been nearly as fast. It was really nice that the pins were broken out to individual headers on the protoboard – that made development tremendously easy. The ready-to-go protoboard surface mount pads helped significantly as well. My best guess is that our development time would have been twice as long if we hadn't gotten these benefits in the development kit."

During flight, the rocket performed perfectly. It wasn't until on the way down that ASA had a scare in the form of a failed main parachute. Upon landing, their data told revealed a 61G impact. Even though the backup parachute successfully protected the entire rocket, it was pretty impressive that the Rabbit withstood the shock.

Commercial spin-off

There has already been a product spin-off from the project: a data acquisition system aimed toward the high-powered rocketry community. The rocketry community is all about size – how small can you get it? The Rabbit will enable a product which can be taken to market that will be superior to anything currently available for a data acquisition system in high-powered rocketry applications.

The first thing that struck the ASA designers was how small the RCM2300 was for what it did. That was extremely important because there was not a lot of space to work with. The benefit over say, a PIC processor, is that the Rabbit not only has three times the processing power but also has all the extra overhead and the flash memory interfaces that need to be added onto a PIC.

So what is in store for ASA?

The launch described here is in preparation for a space shot to be attempted early next year, using a 12m liquid motor vehicle. It will enter space, reach 120km and return. There will be many Rabbits on that flight. With the design calling for throttle control ability, one Rabbit will be used for liquid motor throttling and data acquisition of the liquid motor; another to analyse power usage and to turn things on and off as they are needed to conserve power.

For more information on ASA, visit: **www.asa-houston.org**

Dominion Electronics are the Australian distributor for all Rabbit products. Ph 9906 6988.

Watching the data coming back to earth, courtesy of the Rabbit and an amateur radio link. Photos: ASA.

SERVICEMAN'S LOG

Nothing succeeds like a good whinge

Some people really are born whingers. Couple that with someone who also refuses to accept responsibility for his own negligence and you've got the classic "difficult" customer – especially when they try to shift the blame elsewhere.

We had a guy bring in a 3-year old Philips TV, claiming that the set had suddenly stopped working and that it was under warranty.

Fair enough.

I was the muggins who was allocated to fix the set. When I switched it on, it was dead. I removed the back and found that the cause was pretty obvious – there was a 130mm crack in the main PC board around the flyback transformer.

This crack was open by over 5mm in some sections and the set had obviously been dropped from quite a height. There were also several cracks and scratches in the case, again consistent with the set being dropped. In view of this, it was quite likely that the 51cm flat picture tube had also been damaged internally – especially the shadow mask which is easily dislodged and gives major uncorrectable colour purity errors.

We had a little meeting and it was decided to confront the client. After all, the purpose of a warranty is to guarantee that the product is fit for its purpose and free of any manufacturer's defects. It is not there for people to claim free repairs if they damage the product through their own negligence! After all, a TV set is not a football.

Well, despite the overwhelming evidence that this set had been dropped from a considerable height, possibly from a wall stand, the client insisted that the set had failed all by itself and that *we* were negligent and had probably dropped it afterwards! We couldn't get through to him that the only course of events consistent with the facts was that the set was working and that it had stopped working only after it was dropped.

I even repaired the crack to show him that that was the only electrical fault with the set, apart from the damaged picture tube which indeed had horrendous purity errors.

A Philips insurance company assessor was called in and, even more amazingly, decided to give the client the benefit of the doubt. And as the 3-year old set was beyond economic repair, it was written off and the client given a new one!

I guess no matter how illogical you are, if you are good enough at whinging, you will win out in the end. Frankly, I have little time for such people and he really should have been told to go take a running jump.

Now what's the address of that whinging school?

Third cab off the rank

I had never even heard of AEA Skysonic TV sets, let alone seen one, until the day George Western brought his CTV-8298S 68cm unit in. I was about third cab off the rank in the list of people he had tried to get to fix his TV and I took it on more out of interest than anything else – especially as the fault was only in the east-west correction circuits.

As it turned out, none of the three preset controls – VR2000 Pincushion, VR2001 Width and VR2002 Trapezium – worked on the E-W Module. I could see from the fresh soldering that a lot of work had already been done around the flyback transformer, horizontal output transistor and east-west modulator diodes but it all had to be checked again. This I did by removing each component to be tested from the circuit but everything checked OK. I also removed the east-west module and checked the output transistor but this was also OK.

As I looked at the chassis, it slowly dawned on me that I had seen this Chinese-built set before. But where? I tried looking at Akai and Teac service manuals but there was no similarity at all. I was about to give up on this approach when I suddenly remembered Masuda. I went through the file on that brand to find a pretty good match with the Masuda S25TXS.

Now that I had a circuit diagram the job had suddenly become a lot easier. I checked all the transistors on the east-west module and then began checking and replacing the electrolytic capacitors. I replaced C330 and C328 on spec but it was C329, a 4.7µF 50V bipolar capacitor, that made all the difference. Despite measuring OK on the capacitance meter, replacing it fixed all the symptoms.

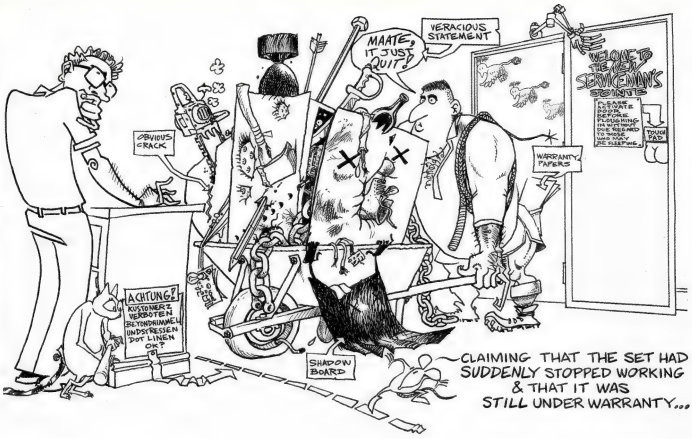
Finally, I realigned the three controls using a crosshatch generator and Mr Western was a happy chappie!

The green Philips

I had another Philips TV (29PT-5783/79R using an A8.0A chassis) come in with no picture. The sound was fine but there was only a very dull green raster on the screen. It took some

Items Covered This Month

- AEA Skysonic CTV-8298S
- Philips 29PT5783/79R TV set (A8.0A chassis)
- Sony KV-EX29M39 TV set (SCC-V41B-A, AG-3E chassis)
- Panasonic TX-68X02A TV set (MX10A chassis)
- Grundig M70-575/90 TV set (CUC5836 chassis)



considerable time to examine the EHT "Info" line (as Philips call it) and the ABL (automatic beam limiter) and video circuits to finally establish that the fault was in the picture tube (A68ESF003X11) itself.

Next, I connected my ancient SWE-CHECK analyser onto the tube with an upgraded adaptor. The neon indicators suggested that there was an unspecified short in the blue gun. I say "unspecified", as the display was not shown in the user's guide for the analyser. I then tried to measure the emission but there was none at all on the blue gun

While I was doing this, the phone rang and I had to answer it, inadvertently leaving the analyser switched on and connected. When I got back, I was amazed to see that the short had cleared and that the emission was fully restored.

Anyway, I reconnected the tube to the set and switched it on. The tube started up as before – a dull green, then a brighter blue and finally a full colour picture. Unfortunately, the greyscale was not only poor but kept changing all the time by itself.

I kept it on test and every so often the short would reoccur but treating it again with the SWE-CHECK always fixed it. However, the repair just wasn't good enough to guarantee, no matter how hard I tried.

Eventually, I recognised that it had to be abandoned and I had to inform the client that the set was beyond economic repair as it needed a new picture tube. He was fairly philosophical about this and promptly went out and bought a new set.

The dead Sony

A 2000 Sony KV-EX29M39 (SCC-V41B-A, AG-3E chassis) came into the workshop marked "dead". However, it wasn't totally dead – the standby LED was flashing twice, indicating overcurrent protection.

A quick check revealed that the line output transistor and flyback transformer were short circuit. It all seemed straightforward and so the client was quoted just to replace these two items, which he grudgingly accepted.

But, quelle horreur! After replacing them, the set was still dead and the LED was now flashing six times, denoting horizontal deflection failure.

Testing the deflection board more thoroughly with the ohmmeter, I found that the 9V rail impedance was down to only 87Ω. This rail was only released when board D1 was removed. Examining this board more closely, I eventually found that op amp IC6107

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(CA0005A, P. BAL CONT)" was the culprit.

Replacing it was easy and fixed the set. The difficult part was re-quoting the client.

An unusual Panasonic

I had an unusual problem with a brand new Panasonic TX-68X02A employing an MX10A chassis. This uses a very small chassis which is tucked under the tube on a plastic frame.

The problem seemed straightforward – there was no sound on the right channel on the AV1 and AV3 inputs. By contrast, AV2 and TV were both OK.

Most sets nowadays have a neat little circuit that automatically ensures that the sound also comes out of the right channel when you connect a mono input into the left channel. This MX10A uses microprocessor IC2101 and IC3007 to control all the AV switching and this circuit was working correctly. The only problem was when using the two rear AV inputs and the monitor output mirrored the sets symptoms.

I started by going to the "Self Check Mode" via the market mode – ie, by reducing the volume level to zero, pressing the OFF TIMER to 30 minutes and then pressing the RECALL on the remote and VOLUME "–" on the TV simultaneously. Everything looked OK, including the options. I then swapped the output AV-Module H-board with one from another set but it made no difference.

By now, it looked to me as though it was the 80-pin surface mounted microprocessor (IC2101, MSP3410GQABB) on the underside of the main board. This was confirmed as being a likely suspect when I spoke to the Panasonic Technical Officer, so I ordered one in and removed the main board from its plastic frame to gain access to the copper side.

Actually, replacing the IC was an interesting exercise, involving a new Hakko 852 ESD SAFE SMP Rework Station air-gun. Hot air was applied for a few minutes via a specially fitting IC tip and, after a gentle rotating action, the IC eventually fell off when the glue gave way (you can get an extra heater that melts the glue faster). The beauty of this was that all the heat was applied directly to the IC pins and did not affect surrounding components. The pads were then cleaned with Soderwick and alcohol.

Next a flux pen was applied over the nice clean solder pads before fitting the new IC. The new IC was then anchored and adjusted into an exact position by soldering just two pads at opposite ends. That done, the solder was melted and allowed to flow all over the pads simultaneously until each leg was soldered. Finally, any shorts left were sucked up with Soderwick and the flux removed using alcohol.

The completed result looked just like the original!

After I had reassembled the set and switched on, I was horrified (again!) to find I now had no sound at all from any source. It took a long time to realise that the fault had to lie with the new IC and so it had to be removed and resoldered. Of course, you wouldn't have been able to do that with an ordinary desoldering station!

As it turned out, there was a short due to a solder "dag" underneath the IC. This was located well behind the legs and so couldn't be seen from the top or side. Oh well, practice makes perfect!

Unfortunately, all this effort with the new microprocessor left me with same symptoms I had started with! But at least I now knew that it wasn't causing the problem.

The problem with using oscilloscopes for checking sound is that it is easy to mistake noise and distortion for sound. The best way is to use a small amplifier probe and your own ears will tell you what you should be getting. I have quite a few of these probes but the downside of this equipment is that it is so easy to blow them up by con-

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necting them to the wrong rails. I am constantly either repairing or making new ones.

Anyway, I was now doing what I should have done right at the beginning and that was trace the input from the right channel, no matter how difficult access was to the miniature copper pattern underneath the board.

With great difficulty, I eventually found the sound was getting to A11 (pin 5) of the microprocessor but was not arriving at pin 57 of IC2101. I then traced the sound to C2005, a surface mounted capacitor, but no further.

A careful examination of the capacitor showed the cause of the whole problem. One end of the capacitor was dry jointed and a quick resoldering job fixed it.

Grunting Grundig

Mr Bayer brought his Grundig TV set in, complaining that it was "grunting". Being a small man, I wasn't quite sure at first whether it was him or the set which he had just carried from his car that was suffering these symptoms. Anyway, I was grateful that he had done so, as I didn't think it likely it could be fixed in his home.

The Grundig M70-575/90 uses a CUC5836 chassis and this was not so much grunting as pulsating, with no sound or picture. I removed the back and went straight to the horizontal deflection stages where I suspected the problem to lie.

First, I unsoldered the separate tripler and tried again. I was not surprised when I next found that the horizontal output transistor (T541, BU508AG) was short circuit. I had never heard of a BU508AG and none of the catalogs had any data on the 'G' version. Fortunately, I did have a service manual which showed the 2SD1432 and 2SD1884 types as equivalents, neither of which I had in stock. However, I had an uprated 2SD1887 which I slipped in.

Before switching the set back on, I removed the flyback transformer (TR529) and checked it with the shorted turns tester. I also checked the tuning capacitors and diodes and all around the horizontal deflection stage, just in case these destroyed the new transistor. Finding nothing wrong, I switched it on again – it was still pulsating but it didn't immediately destroy the new transistor.

I next concentrated on the horizontal drive circuit and replaced IC500 TDA8140, as well as electrolytic capacitors C507 (1000µF 25V) and C541 (220µF 40V). This time, the set rose from the dead with both sound and picture.

The only trouble was that the picture was terrible. First, there was pincushion distortion and severe "cogging" (as I call it). This is a line tearing effect, where the edges of the picture are serrated like a gear cog, especially on bright scenes.

Anyway, I decided to deal with the east-west pincushion problem first.

I removed and examined the module where two ICs handle all the picture correction and it didn't take too long to find that D7012, a 36V zener diode, was almost completely short circuit. Replacing this diode didn't make any difference until I also replaced R546 (4.7Ω) which feeds the horizontal deflection yoke.

All I had left to deal with now was the "cogging". This "smelled" of dried out electrolytics causing ripple on the supply rails. However, after spending a lot of time investigating this – both by using a CRO and by hanging additional electrolytics on the noisier rails – I decided that this was the wrong track. Most rails are noisy anyway and it is difficult to know what is significant and what isn't, especially as there are no details in the service manual.

Back to the start

In the end, I went back to where I started and checked the waveforms around IC500, the horizontal driver. Everything was sweet except for the output on pin 1 and the feedback on pin 3, where the waveforms were unstable. There wasn't much in this circuit which I hadn't already replaced or tested, so I had to repeat my previous work, but this time more accurately measure the components out of circuit.

I had already checked R544 (0.12Ω) in circuit with the DVM and it seemed pretty well right. The circuit I had for a CUC5880 states that it is 0.1Ω but the one in this set was 0.12Ω. I checked it using the ESR low ohms meter and found that it actually measured 0.09Ω. This doesn't seem significant but it is actually about a 25% error.

Anyway, replacing this low-value resistor finally fixed the set. Mr Bayer grunted quite a bit when I gave him the bill. SC

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NEW! 2004

The ultimate toy for the bathtub, pool, or fish-tank. They have full manoeuvrability with forward, back, left, right, and also a power dive button to dive quickly to the bottom. They feature and LED headlight, so they can even drive in the dark! Use two different frequency models to have underwater battles and races! Two frequencies available:

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NEW MODEL

Both Types Each $29.95

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NEW KIT

Ref: Silicon Chip May 2004.

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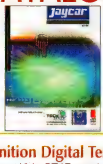

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NEW! 2004

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- Glass Frosted Shade Cat ST-3923 $5.50
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NEW! 2004

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Cat. GH-1350 $14.95

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Cat. GH-1375 **$49.95**

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Cat. AA-2100 **$39.95**

FM Automatic Scan Radio

This FM automatic scan radio searches for radio stations with the touch of a button. It has a brushed aluminium finish which gives it that stylish look.
•44(L) x 44(W) mm
•Freq range: 88-108MHz (FM)

NEW! 2004

Cat. AR-1770 **$9.95**

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NEW! 2004

It produces a maximum 5 watt output. It features a comfortable pistol grip, and a 435mm shoulder strap which makes it portable and comfortable for long periods of use. It is the ideal instrument for sporting events, crowd control and group gatherings.
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•Requires 8 x AA batteries (not incl)
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NEW! 2004

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See website for details.

Cat. XC-4880 **$79.95**

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NEW! 2004

The Laptech is a fantastic aid to anyone who swims laps for competition or fitness. This waterproof timer is simple to use, just tap the face at the end of each lap. In addition to the features you would expect, it records the times of your last 50 laps showing total time and best lap time, best ever 3 laps, and much more.

Cat. XC-0210 **$59.95**

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NEW! 2004

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Cat. QH-7292 **$59.95**

It offers a good indication of blood alcohol levels, but should not be relied upon and you should never drink and drive.

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Gives a simple Go or No Go indication of blood alcohol. An LED illuminates at over 0.05% blood alcohol.
See website for details.
Was $29.95

SAVE $10

Cat. QH-7290 **$19.95**

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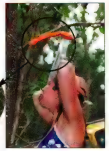

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This splash proof radio is designed to hang on the shower head and isn't bothered by steam or the occasional splash of soapy water. The radio also has a fold-out anti-fog mirror so you can actually shave in the shower (blade only - of course).
Actual model is white.

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Endless fun for all jokers old enough to understand. This animated man turns his head, drops his pants and lets off a series of rip-roaring farts when someone passes by. Uses 3 x AA batteries, included.

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NEW! 2004

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Safe for Kids

Cat. YS-5545 **$9.95**

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For the Practical Joker's bar.. He looks to see who's watching, then opens his coat and drops his pants while playing a great mix of tunes. Hilariously funny.

Cat. GT-3102 **$24.95**

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Dynamo and induction powered devices for endless power (with a little help from you). The torches are great for emergency or backup situations because as long as you can pump or wind them, they will never run out of power. See also the Faraday torches on the front page!

NEW! 2004

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Measures: 130(L) x 50(W) x 45(D)mm.

NEW! 2004

Cat. ST-3337 **$29.95**

Faraday Hand Powered 8 Digit Calculator

The battery free calculator is powered by shaking the calculator side to side. If the screen starts to fade, you won't lose your information - just shake it again for more power. Functions include ON/C, CE , +, -, X, ÷, % M+, M-, and MRC.
•135(L) x 85(W) x 20(D)mm.

Cat. QH-7275 **$14.95**

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Ever been caught in the dark with a torch but no batteries that work? This torch has a small dynamo inside that powers the globe when you pump the handle. A torch that lasts forever, no batteries required!
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This attractive universal remote control is pre-programmed and has a built in dynamo that charges the internal cell which runs the unit. Just a few easy turns per day is all that is needed to keep the remote fully charged.•210(L) x 55(W) x 30(H)mm.

Cat. AR-1718 **$59.95**

Remote Controlled Flying Saucer

A fantastic toy for kids of all ages. This untethered, radio controller flying saucer soars into the air as you pull the trigger on the pistol-grip remote controller. Flying height can be varied and you can climb and descend at will. Flying time depends on how vigorously you fly the saucer and varies up to several minutes. The launch pad/charger can be powered by the supplied mains adaptor or fitted with optional 'AA' batteries and will re-charge the saucer in less than 10 minutes. The flying saucer is fitted with its own rechargeable battery. Recommended for indoor use only.
•Saucer diameter 230mm.

DUE LATE MAY

NEW! 2004

Cat. GT-3004 **$69.95**

FANTASTIC NEW ADDITIONS TO OUR RANGE OF BOOKS

We have a great new selection of books available. For full details and information, see our new 2004 catalogue or website.

Technology for the Older Generation

NEW! 2004

A great range of books to help explain and guide the older generation around modern technology.

Computing for the Older Generation
Cat. BB-7060

Internet for the Older Generation
Cat. BB-7062

Find Anything on the Internet for the Older Generation Cat. BB-7064

Digital Photography & Computing for the Older Generation Cat. BB-7066

Creative Gardening with a Computer for the Older Generation Cat. BB-7068

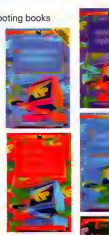
Internet Banking and Shopping for the Older Generation Cat. BB-7069

ESPECIALLY WRITTEN FOR THE OVER 50's

Any Book (Each) **$29.95**

Computing

A range of useful instructional and troubleshooting books for computing.



Windows XP for Beginners
Cat. BB-7070

Windows XP Explained
Cat. BB-7072

Easy Windows XP Troubleshooting
Cat. BB-7074

Easy Internet Troubleshooting
Cat. BB-7076

Easy PC Troubleshooting
Cat. BB-7078

Easy PC Website Construction
Cat. BB-7080

Digital Photography with a Computer
Cat. BB-7082

Using Photoshop 7
Cat. BB-7084

Easy PC Peripheral Troubleshooting
Cat. BB-7086

PC Interfacing Using USB
Cat. BB-7088

Easy PC Interfacing
Cat. BB-7090

Any Book (Each) **$19.95**

Electronics

Great additions to our range of Electronics references.

AVR an Introductory Course
Cat. BT-1372 **$89.95**

NEW! 2004

World's Transistors Diodes Thyristors & IC's Comparison Tables Vol.1 A - Z
Cat. BH-4594 **$39.95**

World's Transistors Diodes Thyristors & IC's Comparison Tables Vol.2 1n…60,000…u
Cat. BH-4595 **$39.95**

Robotics

These robotics books are so great - they each deserve a special mention. Further information can still be found in our 2004 catalogue, or on the website.

Combat Robots - Everything You Need to Build, Compete and Win

NEW! 2004

This book, written by Robot Wars veteran Chris Hannold goes into considerable detail on the core subjects you need to master to understand this discipline. Covered are subjects like Electronics and Wiring, Remote Control by RF, Servos, Wheels, Batteries, Motors, Weapons systems, 3 actual robot designs with CD-ROM Plans, and much, much more. Once you have read this book, you are ready to rumble!
•Softcover 230 x 180mm, over 300 pages.

Cat. BT-1363 **$49.95**

Robot Builder's Sourcebook

If you are going to really get serious about robot construction, you must have this massive book! It is so good, Jaycar is even listed in it!! It lists suppliers of all the bits-in-pieces you are ever likely to need to pursue the construction of your dream machine. It also includes lists of relevant books, societies, help groups, services, you name it. You not only get component sources, you get materials sources, as well as manufacturing facilities. In all, over 2,500 sources for robot parts. OVER 700 PAGES!!!

NEW! 2004

Cat. BT-1365 **$49.95**

Robotics, Mechatronics, and Artificial Intelligence

We have never seen a book before that encapsulates a subject from beginner to serious constructor in one volume. This book encompasses all of the basic control systems – along with the philosophy behind them. The format is extremely practical in that the author provides - literally - hundreds of useful circuits, which are invaluable to practical design. Indeed the components specified are mostly available from Jaycar. •Softcover 230 x 150mm 297 pages

Cat. BT-1370 **$110.00**

USB 2.0 Video Capture Box

This great device can be used to preview, record, or playback your movies from VCR, camcorder, or DVD on your PC. Video can be captured using MPEG1 or MPEG2 format which can be edited and burnt. Use the snapshot feature to capture still images for an electronic photo album. Compatible with Windows 98/Me/2000/XP.
•Includes capture and editing software.
•InterVideo WinProducer 3 to edit & burn as VCD or DVD disc. •Snapshot capability. •High resolution up to DVD quality. •Supports resolution up to 720x480(NTSC) / 720x576(PAL).
•Max frames per second: 29.2.

NEW! 2004

Cat. QV-3090 **$99.00**

Video Enhancer and Stabiliser for S-Video

Home VCRs are not designed to produce high quality copies of video tapes and you will usually get poor results when making copies of your favourite tapes.

By adding a small high frequency boost to the video signal, this degradation can be reduced and a better copy obtained. The system will also remove some copy protection information including 'Macrovision 4' which can degrade quality. Mains plug pack and RCA cable supplied.

NEW! 2004

Cat. AR-1822 **$129.95**

4 Channel BNC to RJ45 Video Balun TX/RX

NEW! 2004

Connect up to 4 CCD cameras to a single CAT 5 cable. It simplifies surveillance cabling and increases transmission distance by converting from coaxial to Cat 5 cable. Cat 5 cable is low cost, easy to install and commonly used in computer, tele-communications and data industries. One of these devices is required on each end.

Transmission Distances (approx.)

Solid Wire:	B/W video signal - 500m
	Colour video signal - 300m
Stranded Wire:	B/W video signal -360m
	Colour video signal - 180m

Cat. QC-3427 **$79.95**

JC80 Double 8" Speaker Kit

This brand new speaker kit includes 2 fabulous Vifa 8" Woofers and a Vifa D26 tweeter. The woofers include 30oz magnets, long throw butyl rubber surround, mineral filled mica polycone supported on a very rigid die cast magnesium basket. The tweeter is a high power Vifa D26 which provides accurate response and high performance. The crossovers are pre-built. This kit is based on the ever popular JV60 kit, which we sold for a number of years, and outperformed speakers costing twice the price and more. Power handling is 100WRMS, and impedance is 4 ohms. Limited quantities available, so be quick to avoid disappointment.

Speaker Kit - Pair

Includes 4 woofers, 2 tweeters, 2 crossovers with polyswitches, rear terminals, ports, innerbond, and self tapping screws for mounting speakers and crossovers.

Cat. CS-2580 **$589**

Cabinets - Pair

These are fully built with a light wood grain finish. Grills supplied with speaker cloth mounted. You simply solder the crossover wires and screw the speakers in.

Cat. CS-2582 **$379**

STRONG DOLLAR $1 YOU SAVE!

OUR MASSIVE 424 PAGE CATALOGUE IS NOW AVAILABLE!

Find it in store for $3.95, or get it FREE when you purchase the May issue of Silicon Chip

Party Speakers

These specialised party speakers don't claim to be HiFi speakers, but they do provide good performance in difficult locations such as backyards, tents, party rooms, and halls etc.

12" - 100WRMS Power Handling

100WRMS power handling, 12" woofer, 2 x piezo tweeters, and a wide dispersion piezo horn. **Was $159**

SAVE $20

Great New Low Prices

Cat. CS-2512 **$139**

STRONG DOLLAR $1 YOU SAVE!

15" - 120WRMS Power Handling

120WRMS power handling, 15" woofer, 3 x piezo tweeters, and a wide dispersion piezo horn. **Was $209**

SAVE $30

Cat. CS-2515 **$179**

30 WRMS 6.5"Home Unit Sub-Woofer

Now you can have a great sounding, powered subwoofer, even if you live in a home unit of flat. It uses a 6.5" sub, powered by a 30WRMS subwoofer amplifier. Excellent sounding bass. **Was $169**

SAVE $20

Cat. AA-0512 **$149**

3 Way Weather Resistant Speakers - Pair

These great speakers house a 4" polycone mid, 2" mylar mid tweeter and a 3/4" cloth tweeter. The cabinet is made from high impact black plastic, with a metal perforated grill. 90dB sensitivity, 4 ohm impedance, and 25WRMS power handling. Limited quantity available.

NEW! 2004

BARGAIN

Cat. CS-2432 **$89.95**

Size: 203 x 133 x 127mm

3 Piece Add On for Surround Speaker Systems

This kit includes a shielded centre speaker, containing a 4" mid woofer and 2" tweeter, and a set of satellite speakers, each with a 4" heavy duty full range driver. They have black ABS cabinets with cloth grills. 6-8 ohm impedance, and 25WRMS power handling. Limited quantity available.

Sizes: Centre: 286x184x127mm
Satellites: 181x89x127mm

STRONG DOLLAR $1 YOU SAVE!

BARGAIN

NEW! 2004

Cat. CS-2465 **$99.95**

Universal Amplifier Modules

Suitable for a number of applications, they feature flexible input voltage, and suit a range of speaker impedances. Great value. See website for details.

3.5 Watt
Cat. AA-0225 **$17.95**

12 Watt
Cat. AA-0225 **$23.95**

40 Watt
Cat. AA-0227 **$44.95**

Analogue VU & Voltage Meter for Cars

This great DIN mounting display features 3 analogue meters. It has 2 x VU meters, which require a line level throughput to your head unit, and 1 x voltage meter, so you can always keep an eye on your car's battery condition. The blue meters look great providing some old-school style relief from the digital meters we so commonly see. The case is standard 1u DIN mount.
See website for details.

NEW! 2004

Cat. QP-5035 **$89.95**

Personal PA Systems

Designed to be worn around the waist. Both systems are surprisingly loud for their size, and are great for small PA applications such as in-store demonstrations, tour guides and lecturers etc. Allows hands free operation.

Compact System

Supplied with a 9V battery for power. **Was $49.95**

SAVE $5

Cat. AM-4054 **$44.95**

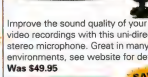
Deluxe Rechargeable System

Supplied with charger, requires 6 x AA rechargeable batteries. **Was $99.00**

SAVE $10

Cat. AM-4052 **$89.00**

Stereo Camcorder Microphone



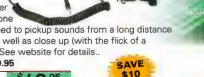
Improve the sound quality of your home video recordings with this uni-directional stereo microphone. Great in many environments, see website for details. **Was $49.95**

SAVE $10

Cat. AM-4083 **$39.95**

Shotgun Video Camera Microphone

This high quality electret condenser microphone is designed to pickup sounds from a long distance away, as well as close up (with the flick of a switch). See website for details.. **Was $59.95**



SAVE $10

Cat. AM-4085 **$49.95**

MASSIVE METER REDUCTIONS

See website for all details and specifications.

Mini Low Cost Digital Multimeter

- 10A Current
- Transistor Test
- Limited Quantity

Was $11.95

SAVE $5

Cat. QM-1495 **$6.95**

Low Cost DMM

- 10A Current
- Transistor Test
- Diode Test

Was $14.95

SAVE $5

Cat. QM-1500 **$9.95**

Data Hold DMM

- 10A Current
- Low Battery Indicator
- Includes Holster

Was $19.95

SAVE $5

Cat. QM-1520 **$14.95**

Backlit Temp DMM

- Professional Look
- Continuity Tester
- Data Hold

Was $29.95

SAVE $5

Cat. QM-1526 **$24.95**

Low Cost Auto Ranging Digital Multimeter

SAVE $4

- Peak Hold
- Data Hold
- Transistor Tester

Was $29.95

Cat. QM-1534 **$25.95**

Auto Ranging DMM

- Capacitance
- Relative Measurement
- Frequency

Was $39.95

SAVE $5

Cat. QM-1535 **$34.95**

Frequency DMM

- Temperature
- Capacitance
- Auto Power Off

Was $59.95

SAVE $10

Cat. QM-1320 **$49.95**

Inductance DMM

- Capacitance
- Temperature
- Transistor Tester

Was $59.95

SAVE $10

Cat. QM-1445 **$49.95**

Extra Large Digit Digital Multimeter

- Capacitance
- Frequency
- Temperature
- Data Hold
- Backlight
- Limited Quantity

Was $79.95

SAVE $20

Cat. QM-1450 **$59.95**

Auto-Ranging DMM

- Capacitance
- Bargraph
- Data Hold
- Frequency
- Continuity Tester
- Transistor Tester

Was $79.95

SAVE $20

Cat. QM-1530 **$59.95**

True RMS Auto-Ranging DMM

- Data Hold
- Relative Measurement
- Duty Cycle
- Frequency
- 40M Ohm Resistance
- Capacitance

Was $89.95

SAVE $10.95

Cat. QM-1536 **$79.00**

Autoranging RS-232 Digital Multimeter

- Duty Cycle
- Frequency
- Dual Temperature
- Capacitance
- Continuity Buzzer
- Diode Tester
- Backlit LCD
- 4000 Count
- Cat III 1000V
- RS-232 Interface
- Includes Temperature Probe
- Includes Holster

Was $169.95

DIGITECH

SAVE $30

Cat. QM-1460 **$139.95**

Protek 506 - Auto Ranging Computer Connect

- Dual Display
- True RMS
- Capacitance
- Continuity
- Auto Power Off
- Bargraph
- Relative Measurement
- Data Hold
- Inductance
- 20A Current
- Logic Tester
- 10MHz Frequency
- Temperature
- Diode Tester
- Recording (Min, Max, Avg)
- 4000 Count
- Includes Temperature Probe
- Includes Holster

Was $299

SAVE $69.05

Cat. QM-1290 **$229.95**

10MHz Single Trace Budget CRO with Probe

This unit is ideal for the professional or dedicated enthusiast, who only needs the occasional use of a CRO. It features a powdercoated steel case, 75mm CRT with 5mm square graticule and more. It has standard sensitivity of 5mV/DIV to 5V/DIV,with sweep from 0.1µS/DIV to 0.1S/DIV. See website for details.

Was $379

SAVE $50

Cat. QC-1910 **$329**

10MHz Velleman Handheld LCD Oscilloscope

The Velleman Handheld Oscilloscope is a complete, portable unit, all at the size and cost of a good multimeter. Features include a high contrast LCD with wide viewing angle, full automatic setup, true RMS and sound level measurement. See our website for full details.

Was $349

SAVE $40

Cat. QC-1916 **$309**

1500W (2500W Surge) Electrically Isolated 24VDC to 230VAC Pure Sine Wave Inverter

NEW! 2004

With an input of 24V DC, this inverter can be used in trucks, buses, semi trailers or fixed installation 24V battery banks. It bristles with protection circuits including battery over/under voltage alarm, over temperature alarm, overload and short circuit protection and much more. See our 2004 catalogue or website for details. Note: Remote control sold separately Cat MI-5086.

Cat. MI-5089 $999

LASCAR 1.5 - 30VDC @ 1A Switchmode Lab Power Supply

Lascar has taken its panel meter and power supply expertise and fused it together to produce this stylish compact switchmode power supply. It features a backlit dual 3 digit LCD display, which indicates output voltage and current.

Cat. MP-3095 $199

NEW! 2004

23 Piece Ratchet and Bit Set

NEW! 2004

This handy set will compliment any workshop. It features a compact design so you can add it to your existing tool case without losing too much space. The metal storage case is strong and durable, ideal for people on move. See 2004 catalogue/website for full details

Cat. TD-2029 $29.95

75Ω Inline Fixed Attenuators

Fixed attenuators are a handy way to resolve ghosting and reflections caused by too higher signal strength created by RF or Video signals. BNC, F-Type and RCA fixed attenuators will address this problem.

- Bandwidth: 5MHz to 1GHz.
- All are inline (socket to plug).

F type shown

NEW! 2004

-3dB RCA Cat. LT-3051	-3dB F Cat. LT-3052
-3dB BNC Cat. LT-3053	-6dB F Cat. LT-3054
-6dB BNC Cat. LT-3055	-12dB F Cat. LT-3056
-12dB BNC Cat. LT-3057	All Types (Each) $7.95

3-28V Wireless Automotive Voltage Tester

This professional grade wireless voltage tester is designed for use on modern cars. It will light up, buzz, and vibrate when positive voltage is detected. It is safe to use with ECU's, air bags, sensors, transducers etc.

Cat. OP-2212 $29.95

NEW! 2004

90-300VAC/DC Voltage Tester

This small circuit tester allows you to test for live circuits between 90V to 300V. A neon light illuminates to indicate voltage detection. It also has a pocket clip to prevent it from falling out while getting into those awkward places.

Cat. OP-2240 $3.95

NEW! 2004

F Type 75Ω DC Blocking Module

DC Blocking modules stop the DC voltages from powered RF Amplifiers travelling into TV sets or other devices. It is a low cost protection for expensive TV sets or equipment.

Cat. LT-3070 $16.95

NEW! 2004

Neon Spark Plug Tester

Have you ever found yourself paying a motor mechanic to rectify a faulty spark plug because you did not know what the problem was? Well now you can test this yourself by using this spark plug tester. Ideal for the mechanic, auto electrician, auto club member or just the average motorist.

Cat. OP-2264 $5.95

NEW! 2004

Stud/Metal/Volt Tester

This easy to use 3-in-1 detector can show the location of metal, voltage, and wooden studs behind walls, plywood, or flooring up to 3/4 inch thick. It is a very versatile and portable tool that fits into the pocket of a renovator, builder or just the average handyman ready for use.

Cat. OP-2282 $29.95

NEW! 2004

100:1 Oscilloscope Probe Kit

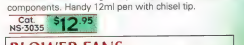
Suitable for use with all CRO's in our range. Attenuation Ratio: 100:1. Bandwidth: DC to 250MHz.

Cat. QC-1903 $59.95

NEW! 2004

Surface Mount Rework Flux Pen

NEW! 2004



This SMD Rework Flux is a quick drying, no-clean flux for use when removing or replacing surface mount components. Handy 12ml pen with chisel tip.

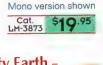
Cat. NS-3035 $12.95

Stereo RF Modulator for Audio/Video

NEW! 2004

This stereo modulator converts a Video, Left and Right Audio signal to an RF or 'Antenna' type signal to connect directly into a TV which only has a TV aerial socket. This is commonly required for older TV sets.

- Channels 0 and 1.
- Requires 12VDC @ 100mA.
- Use Plugpack MP-3002



Mono version shown

Cat. LM-3873 $19.95

SPDT 60A Horn Relay

NEW! 2004

This relay is ideal for any high current switching application eg. Amplifiers, ignition cutout, transmitters, car spotlights, and more. 12V nominal coil voltage.

Cat. SY-4074 $8.95

BLOWER FANS

76mm x 75mm 12VDC Blower Fan Standard

Air Volume: 0.27(m3/min), 9.5(CFM)
Bearing System: Sleeve
Speed: 2,700 RPM
Current: 200mA

Cat. YX-2530 $17.95

NEW! 2004

97mm x 94mm 12V DC Blower Fan Ball Bearing

Air Volume: 0.74 (m3/min), 26(CFM)
Noise: 51dB(A)
Bearing System: Ball
Speed: 3,600 RPM
Current: 860mA

Cat. YX-2532 $29.95

NEW! 2004

Professional Quality Earth - First Gold RCA Connectors

NEW! 2004

"Earth First" RCA connectors use a retractable earth sleeve which ensures the earth path is connected before the signal. Very important when working with powered equipment. Pro quality with gold plating.

Red Cat. PP-0222
Black Cat. PP-0224

Each Colour $6.95

Concrete Cable Tie Mounts

These handy cable tie mounts make it possible to use cable ties in runs along walls and ceilings made of brick or concrete. UL 94V-2 approved Nylon.

Pk 20	Cat. HP-0795 $4.50
Pk 100	Cat. HP-0796 $18.95

NEW! 2004

Luxeon Star LED Driver Kit

NEW KIT

Ref: Silicon Chip May 2004

This great kit allows you to power 1W, 3W, or 5W Luxeon Star LEDs from a 12V power source. This means that you can take advantage of what these super high power devices have to offer, and utilise them in your car, boat, or caravan. Kit supplied with PCB, and all electronic components.

Cat. KC-5389 **$29.95**

AC/DC Current Clamp Meter Kit for DMM's

SAVE $8

Ref: Silicon Chip Sept 2003.

A great low cost alternative to expensive current clamp meters. It uses a simple hall effect sensor and iron ring core setup and connects to your digital multimeter. It will measure AC and DC current and has a calibration dial to allow for any magnetising of the core. Much cheaper than pre-built units. Kit supplied with PCB, clamp, case, silkscreened front panel and all electronic components. **WAS $34.95**

Cat. KC-5368 **$26.95**

Serial PIC Programmer Kit

Ref: Silicon Chip Sept. '2003.

This great little programmer features a portable, robust design and has provisions for In Circuit Serial Programming (ICSP) for micros which support this programming feature. This avoids the need to unplug a PIC from it's circuit to make and test changes to the code. It simply connects to your PC's serial port. Kit supplied with PCB and all electronic components. ZIF socket, serial cable. Battery not supplied.

Cat. KC-5367 **$44.95**

Studio 350 - High Power Amplifier Kit

Ref: Silicon Chip Jan/Feb 2004.

This fantastic new amplifier kit will deliver 200WRMS into a 8Ω load, or 350WRMS into a 4Ω load. It is super quiet, with a signal to noise ratio of - 125dB(A) at full 8Ω power. Harmonic distortion is a fantastic 0.002% and frequency response is almost flat between 15Hz and 60kHz. Kit supplied in short form including PCB & all electronic components. Kit requires heatsink and +/-70V power supply.

Cat. KC-5372 **$175**

See in store for our great deal on power supply components for this kit!

Valve Audio Pre-Amp Kit

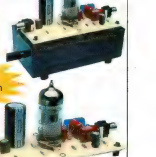
Ref: Silicon Chip Nov 2003.

AT LAST! A valve based preamp kit! It uses a 12AX7 valve and offers excellent performance.

Kit supplied with PCBs, case, valve, ferrite cores, bobbin and clips and all electronic components. Requires 12VDC @ 250mA.

Cat. KC-5370 **$89.95**

These include all components for the Hi-Fi conversion described in Feb Silicon Chip



Valve Preamp Add-On Kit

Ref: Silicon Chip November 2003.

Add to KC-5370 for a stereo valve preamp. Powered from KC-5370, so no extra power is required. Kit supplied with PCB, valve and all electronic components.

Cat. KC-5371 **$59.95**

YOUR LOCAL JAYCAR STORE

NEW SOUTH WALES	
Albury	**•Ph (02) 6021 6788**
Bankstown	**•Ph (02) 9709 2822**
Bondi Junction	**•Ph (02) 9369 3899**
Brookvale	**•Ph (02) 9905 4130**
Campbelltown	**•Ph (02) 4620 7155**
Erina	**•Ph (02) 4365 3433**
Newcastle	**•Ph (02) 4965 3799**
Parramatta	**•Ph (02) 9893 3377**
Penrith	**•Ph (02) 4721 8337**
Silverwater	**•Ph (02) 9741 8557**
St. Leonards	**•Ph (02) 9439 4799**
Sydney City	**•Ph (02) 9267 1614**
Taren Point	**•Ph (02) 9531 7033**
Wollongong	**•Ph (02) 4226 7089**
VICTORIA	
Coburg	**•Ph (03) 9384 1811**
Frankston	**•Ph (03) 9781 4100**
Geelong	**•Ph (03) 5221 5800**
Melbourne	**•Ph (03) 9663 2030**
Ringwood	**•Ph (03) 9870 9053**
Springvale	**•Ph (03) 9547 1022**
QUEENSLAND	
Aspley	**•Ph (07) 3863 0099**
Brisbane - Woolloongabba	**•Ph (07) 3393 0777**
Gold Coast - Mermaid Beach	**•Ph (07) 5526 6722**
Townsville	**•Ph (07) 4772 5022**
Underwood	**•Ph (07) 3841 4888**
AUSTRALIAN CAPITAL TERRITORY	
Canberra	**•Ph (02) 6239 1801**
TASMANIA	
Hobart	**•Ph (03) 6272 9955**
SOUTH AUSTRALIA	
Adelaide	**•Ph (08) 8231 7355**
Clovelly Park	**•Ph (08) 8276 6901**
WESTERN AUSTALIA	
Perth	**•Ph (08) 9328 8252**
NEW ZEALAND	
Newmarket - Auckland	**•Ph (09) 377 6421**
Glenfield - Auckland	**•Ph (09) 444 4628**
Wellington	**•Ph (04) 801 9005**
Christchurch	**•Ph (03) 379 1662**
Freecall Orders	**•Ph 0800 452 9227**

'Smart' Fuel Mixture Display Kit for Cars

NEW KIT

Ref: Silicon Chip April 2004.

We have sold thousands of mixture display kits over the years, providing many enthusiasts with a great meter for their car. This new version incorporates new and improved features such as better circuit protection, a dimming function for night driving, and an emergency lean-out alarm. Supplied with PCB & all electronic components. Car must be fitted with air flow and EGO sensors.

Cat. KC-5374 **$27.95**

"Quick Brake" - Emergency Brake Light Trigger Kit

Ref: Silicon Chip March 2004.

Now you can put on your brake lights even before you touch the brake pedal! It triggers when you rapidly lift your foot off the throttle, as you would to put it on the brake, so following motorists are warned that you're stopping much earlier! Works with standard throttle position sensors. Kit supplied supplied with PCB, wire and all electronic components.

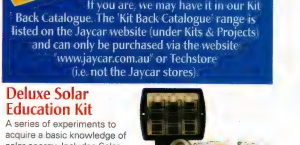
Cat. KC-5373 **$24.95**

50MHz Frequency Meter Kit

Ref: Silicon Chip Oct '03.

Very accurate, large 8 digit display. Kit supplied with PCB, laser cut silk screened panel, pre-programmed micro, and all specified electronic components.

Cat. KC-5369 **$69.95**



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PRODUCT SHOWCASE

Knock, Knock . . . Who's There . . . It's Me . . .

Every now and then, a product comes along which is so simple, yet so clever in solving a problem, that you wonder why it hasn't been thought of before. Knock-In-Key is such a product.

It's sole purpose is to ensure you are never locked out of your car again (a staggering 950,000 people last year alone in Australia are estimated to have locked their keys in their car).

With no external devices or traditional keys, Knock-In-Key allows you to operate the vehicle's central door locks by simply knocking a predefined code on the vehicle's glass or panel.

Now you can throw away the coat hanger or packaging tape! And no more waiting around for an hour or more for road service to arrive.

And if you happen to have broken your key off in the lock, you're no longer in trouble.

It's a simple idea but not simplistic when it comes to security. Knock-In Key requires the user to pick their own sequence of 5 to 12 "knocks" (such as knock-knock-knock, knock-knock-knock-knock, knock). Knock the right combination and the doors unlock!

It won't allow simple combinations of more than two repeated numbers at a time and three failed attempts at the code will block the knock access to the vehicle for one hour. It also requires the user to input a new code after it has unlocked the doors in case anyone saw them enter. This all means that your vehicle's security is not compromised by this ingenious little helper.

The unit measures just 52 x 37 x 20mm and features easy installation – well within the capabilities of anyone with auto electrical and/or traditional car security knowledge.

With a recommended retail price of $129.00, Knock-In-Key is being currently being launched in NSW with a national launch to follow soon. Dealer enquiries are welcome.

Contact:
Aggeggi
64 Beresford Ave, Greenacre NSW 2019
Tel: (02) 9707 4933 **Fax**: (02) 9707 4805
Website: www.knockinkey.com.au

Computer books for the annually challenged

We've lost count of the number of times here at SILICON CHIP we talk to older people about using computers and the internet and the response is "Oh, I'm too old to start learning those things" or somesuch nonsense.

Well now there really is no excuse with these two new titles from Jaycar: "The Internet for the Older Generation" and "Digital Photography and Computers of the Older Generation" are written especially for the over 50s (not that there aren't a few young'uns who'd get a lot from them as well!).

They feature easy-to-understand language and large, clear type. Both are around 200 pages and have a recommended retail price of $29.95. They're available at all Jaycar Electronics stores. If you've never wanted to get into PCs – here's your big chance!

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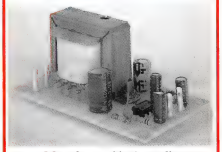

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Two new stores makes 35 for Jaycar Electronics

As part of an ongoing expansion program, Jaycar Electronics has opened two new stores, one in Taren Point (southern Sydney) and another in Albury (on the NSW/Victorian border), bringing the total number of Jaycar stores to 35 Australia-wide.

Jaycar brings to the areas many years of retail experience and a proven product range covering home and car alarm systems, test equipment, video surveillance, car audio, electrical & electronic tools, wire, cable and accessories along with an extensive range of electronic equipment and kits.

Each store will employ up to 5 local staff in a combination of full time and casual positions.

The Taren Point store is located at 49A Captain Cook Drive (Ph 9531-7033) and is open 7 days.

The Albury store is at 565 Hume Street (Ph 6021-6788).

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PO Box 6424, Silverwater NSW 1811.
Tel: (02) 9741 8555 **Fax:** (02) 9741 8500
Website: www.jaycar.com.au

Two new Nikon digitals for advanced photographers

Maxwell Optical Industries P/L, Australian Nikon Imaging Company distributor, has announced the immediate local availability of two high-end digital cameras - the D70 digital SLR and the Coolpix 8700, Nikon's flagship 8 Megapixel digital compact.

Nikon D70 Digital SLR

At under $2000 (body only), the Nikon D70 employs the Nikon DX format 6.1 megapixel sensor and Nikon F lens mount design. This maintains seamless compatibility with all AF Nikkor lenses while allowing photographers to take full advantage of high quality DX Nikkor lenses designed exclusively for Nikon's D-series digital SLR cameras.

Developed concurrently and designed as a perfect match for daily use with the D70 and to deliver top performance and outstanding value, the new AF-S DX Zoom-Nikkor 18-70mm f/3.5-4.5G IF-ED is also ready to join the lineup.

The D70 is also backwards-compatible with most Nikkor lenses, meaning that owners of Nikon film SLRs can use their existing optics with the new digital model.

The Nikon D70 body is priced at $1999 and $2299 with the new Zoom-Nikkor 18 - 70mm lens.

Nikon Coolpix 8700

With an impressive 8.0 effective megapixels and a powerful 8x zoom lens, the COOLPIX 8700 is positioned as Nikon's flagship digital compact

The camera primarily targets users who already explore advanced forms of photographic expression, but are looking for something more in a compact digital camera.

The professional-quality 8x Zoom-Nikkor has 8.9 - 71.2mm focal range (equivalent to 35 - 280mm in 35mm format), the lens incorporates two ED (Extra-low Dispersion) lens elements to minimize chromatic aberration and deliver clear and crisp image reproduction.

The Coolpix 8700 has an RRP of $1999.

Both the D70 and 8700 are available at leading camera retailers.

FOOTNOTE:

SILICON CHIP has had the chance to play with a Nikon D70 over the past two weeks. We'll tell you all about it in the June issue!

Contact:
Maxwell Optical Industries Pty Ltd
Locked Bag 2055, Lidcombe NSW 1825.
Tel: (02) 8748 5200 **Fax:** (02) 8748 5220
Website: www.maxwell.com.au

Adding USB support

Elexol's low cost USBIO24 module is one of the fastest ways you can add input and output USB support to any device. These development modules provide an interface between the USB port of a PC and external circuitry.

The module features 24 5V level signal lines individually programmable as input or output as well as capabilities for further expansion via the expansion port. As the module connects to the USB port, multiple modules can be connected to a single PC by the use of a USB hub or hubs. Each module features a serial number and the PC can identify each module uniquely allowing for multiple modules to be connected for a single application.

The outputs of the module are able to source or sink up to 30mA per I/O.

Contact:
Elexol Pty Ltd
PO Box 5972, GCMC, Bundall, Qld 4217.
Tel: (07) 5574 3988 **Fax:** (07) 5574 3833
Website: www.elexol.com

Adelaide electronics suppliers merge

Adelaide-based Tytronics and Tekelek have merged their businesses to be known as Tekstream. The new organisation plans on becoming a major competitor in the specialist electronics service sector.

Tekelek was Australia's largest producerofadvancedelectroniccontrolsfor air-conditioners and heaters, supplying industry leaders such as Carrier, Honeywell, Climate Technologies and Seeley International, while Tytronics was also involved in the HVAC market and is a global leader in electronic gas ignition systems, with wide experience in contract manufacturing and supply services.

Contact:
Tytronics/Tekstream
PO Box 2220 Port Adelaide SA 5015
Tel: (08) 8268 5400 **Fax:** (08) 8268 2503
Website: www.tytronics.com.au

A look inside Altronics new Sydney Distribution Centre

Back in the January 2004 issue we mentioned that Altronics Distributors were opening a new distribution centre in Auburn, in Sydney's western suburbs, to better service the company's Easter States customers.

The new centre was opened amid much fanfare and celebration on February 27 and we went on the Cook's Tour, snapping some shots of this modern facility as we went. Here are just a few of those photos...

The new warehouse (above and below) was designed for maximum efficiency and speed in the movement of goods.

Service hasn't been forgotten, with a service centre able to tackle warranty and general service work.

The retail centre is also state-of-the-art, with superbly lit shelves to make component selection easy and certain.The full range of Altronics catalog products are carried in the retail store.

COMING NEXT MONTH . . .*

"Open Sesame" RFID Door Security Module

Tired of fumbling around in the dark for your keys? Can't find the keyhole on a moonless night? Or perhaps you're just irritated by having to punch in a code each time you want to arm or disarm your security system.

End all these little annoyances and more with the wave of your hand and our modern-as-tomorrow RFID Security Module!

Wot? What Watts?

How much power are you really using? Build this handy energy meter and you'll probably be surprised. If you're wanting to save energy (and power bills) this project will be one of the best investments of the year. Multi-function digital readout will tell you usage, actual power cost and much more.

* These articles are amongst those planned for publication in the June issue of SILICON CHIP

Hot-Swappable SATA removable HDD kit

The simplest way to make sure all your data is safe from theft or fire is to take it with you. The easiest way to do this is with a mobile HDD rack.

Serial ATA Hard Drives are now available and you can take advantage of this extra speed while keeping your data portable. With no drivers required, the hard drive appears as if it is plugged normally into the motherboard. Hot-swapping with these cases has native support in Windows 98/SE/ME/2K/XP and Linux. The case itself is made out of aluminium, this gives the drive extra protection from the bumps and knocks of everyday life.

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1/14 Bon Mace Close,
Berkeley Vale, NSW 2261
Tel: (02) 4387 8444 Freefax: 1800 625 777
Website: www.mgram.com.au

CASIO enters data projector market

CASIO, a familiar name in office technology products, has launched two new high-luminosity mobile projector models (XJ-350 and XJ-450) in its entry into the competitive data projector market.

To complete this new line, CASIO also introduced a new 4-megapixel CCD multi-functional document copy stand (YC-400).

The XJ-350 and XJ450 mobile projectors employ an original new condenser lens and light source lamp that deliver high-brightness images that can be clearly viewed under normal lighting conditions, in a compact, highly portable configuration. The XJ-350 delivers an amazing 2200 ANSI lumens from a minuscule 230mm x 55mm x 171mm size configuration, while the XJ450 with its letter-sized footprint delivers 2800 ANSI lumens.

Both models come with a 2X optical zoom lens, by far the highest zoom level available for any micro-portable data projector, which makes it possible to project onto a screen as close as 0.8 meters. This means that these projectors can be used with ease in environments where meeting space is limited.

The new YC-400 Document Copy Stand & Digital Camera has a high-resolution 4-megapixel CCD and an automatic adjustment feature that automatically corrects the positioning between the camera and subject so that it appears squarely on the screen.

It can be used for instantly projecting images of white board contents, 3-dimensional objects, as a digital scanner and as a fully functioning, stand-alone digital camera.

Contact:
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23-27 Chaplin Dve, Lane Cove NSW 2066
Tel: (02) 9415 5040 **Fax:** (02) 9415 5044
Website: www.casio.com.au

Maxwell's new *350F* ultracapacitor

No, that's not a misprint. Three hundred and fifty FARADS!

Using industry-standard "D" cell battery dimensions, Maxwell's new BOOSTCAP BCAP0350 is a big step forward in ultracapacitors.

The 350F, 2.5V device provides system designers a lower-cost, highly reliable, and standard-sized energy storage and power delivery component for seamless and rapid integration in a variety of applications. It is the first in a series of new ultracapacitors to be standardized on battery-sizing to drive down costs and ease integration of the technology.

As with all BOOSTCAP ultracapacitors, the BCAP0350 can supply bursts of high power and recharges rapidly from any energy source over hundreds of thousands of cycles without significant performance degradation.

The BCAP0350 offers particular benefit to the transportation market where designers can us it to power initial acceleration, operate electrical subsystems and recapture energy from braking for cleaner, more fuel-efficient hybrid electric/internal combustion buses, trucks and automobiles.

For industrial systems, the BCAP0350 provides a simple, solid state, highly reliable solution to buffer short-term mismatches between the power available and the power required.

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Maxwell USA
9244 Balboa Ave, San Diego CA 92123
Tel: (0011) 1 858 503 3300
Fax: (00011) 1 858 503 3301
Website: www.maxwell.com

Tektronix MyScope custom control windows

With MyScope custom control windows and intuitive context-sensitive right-click menus, the TDS5000B Series of DPO oscilloscopes from Tektronix is said to be the easiest to use, most customizable midrange oscilloscope available.

It has standard built-in spectral analysis, equation editor and histogram statistics.

The TDS5000 series captures greater than 100,000 waveforms per second. It has a multi-view zoom with lock and scroll and has 4M/2M/1M standard record length on 1/2/4 channels (optional 16M/8M/4M).

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How many times have you wanted to access a company's website but cannot remember their site name?

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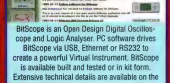

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The photo at left shows the completed power supply module. Position the inductor (L1) so that it's well clear of surrounding components and secure it to the PC board using small cable ties. At right is a 5W Luxeon star LED, shown about 50% larger than actual size.

STAR POWER

High-efficiency supply for Luxeon Star LEDs

Based on a switching regulator IC, this simple project is just the shot for powering 1W to 5W ultrabright Luxeon Star LEDs. It's easy to build, runs off 12V DC and can be easily tailored to suit your requirements.

By PETER SMITH

BACK IN THE December 2003 issue, we presented a simple linear power supply for powering 1W Luxeon Star LEDs from a 12V supply. Predictably, we've already received requests for a version that will drive the newer, brighter 3W Stars. In addition, many constructors want a higher efficiency supply for use in boats, caravans and cars.

This new design fits the bill and includes low battery cutout as well.

Unlike the original design, which is based on a linear regulator, this new supply employs a step-down switching regulator. The advantages of this method include much improved efficiency and significantly reduced heat generation.

In fact, when driving a single 3W Star, this supply is at least twice as efficient as a linear supply or simple current-limiting resistor. Obviously, this means longer battery life. Lower heat generation also means that you can build the supply into a case without the need for additional heatsinking.

The project can be powered from any 12V DC (nominal) supply and can be set up to source 350mA, 700mA or 1000mA of regulated current to suit all of the Luxeon Star LED range.

Block diagram

The circuit is based around a Motorola MC34063 DC-DC converter IC. This chip contains all of the functions necessary to construct a complete low-power step-down switchmode regulator – see Fig.1.

A simplified block diagram of the step-down regulator appears in Fig.2. Essentially, when transistor Q1 switches on, current though the series inductor (L1) increases with time, storing energy in its magnetic field. When Q1 is switched off, the magnetic field collapses and the energy is discharged into the output filter capacitor and load via diode D3.

A free-running sawtooth oscillator in the MC34063 determines the maximum switch "on" time. The "on" time of the switch (Q1) versus its "off" time determines the fraction of the input voltage that appears at the output.

IC1 controls the "on" time by monitoring the voltage on its feedback pin. As this voltage falls below 1.25V, Q1's "on" time increases. Conversely, as the feedback voltage increases, the "on" time decreases. Complete "on" cycles are skipped if the feedback voltage remains above the 1.25V set point for the duration of the "on" period.

In a typical implementation, the feedback pin would be connected to the output via a voltage divider to regulate the output voltage. However, our design regulates output current instead.

Current through the LED(s) is sensed via resistor R1 and amplified by op amp IC2. The result is applied to the

Main Features

- Powers one or two 1W or 3W Stars, or a single 5W Star
- High efficiency for minimum battery drain
- Low battery cutout (11.5V)
- Input polarity & transient protected
- Output short-circuit protected
- Ideal for use in boats, caravans & cars

feedback pin of IC1 via a trimpot, allowing accurate current adjustment.

Simply put, the output current is regulated by maintaining the voltage across the sense resistor at about 100mV. In practice, the actual sense voltage depends on the value of R1 and the position of the trimpot.

Circuit details

The complete circuit diagram appears in Fig.3. Following the circuit from the input voltage side, diode D1 provides reverse-polarity protection. A Schottky type is used here to reduce voltage losses.

Next, a 24V zener diode (ZD1) clamps input transients to less than the maximum voltage rating of downstream components. A 470µF capacitor then filters the input and provides a low-impedance source for the high-frequency switching circuitry.

As described above, transistor Q1 acts as a switch in series with the inductor (L1). A Zetex low VCE_{SAT} (collector-emitter saturation voltage) type was chosen for Q1 to improve efficiency and reduce heat dissipation.

The performance of the switching circuit is further enhanced by a turn-off speed-up circuit, which operates as follows:

During an "on" cycle, transistors internal to the MC34063 switch on, bringing pins 1 & 8 towards ground. This forward-biases the base-emitter junction of Q1 via D4 & L2, switching the transistor on.

When the "on" cycle ends, pins 1 & 8 go open circuit and the current through L2 abruptly ceases. The magnetic field around L2 collapses, generating a voltage of opposite polarity to the charge voltage. This forward-biases the base-emitter junction of Q2, momentarily switching it on and connecting the base of Q1 to its emitter.

This results in significantly faster turn-off of Q1 than is possible with a resistive pull-up alone. By minimising the transition time between saturation and turn-off, collector power dissipation, and therefore switching losses, are effectively reduced.

When Q1 switches off, diode D3 provides a discharge path for the inductor (L1) to the output filter capacitor and load. Again, a Schottky diode is used for its fast switching and low forward voltage characteristics. Note that we've specified high current (3A) devices in order to withstand a continuous short-circuit condition at the output.

In normal operation, the peak current that flows in the transistor and inductor during each switching cycle is well within the limits of the component ratings. However, with an overloaded or short-circuited output, or with excessively high input voltages, the peak current could increase to destructive levels.

To counteract this problem, IC1 senses peak current via a 0.15Ω resistor in series with the input. When the peak voltage across this resistor nears 330mV, the MC34063 progressively reduces the maximum "on" time of the switch by shortening the positive ramp of the oscillator.

Current sensing

A resistor in series with the LED provides a means of sensing output current. The voltage developed across R1 is amplified by one half of a dual op amp (IC2b), which is configured as a differential amplifier. With the resistor values shown, the sense voltage is amplified by a factor of 15 and applied to one end of VR1.

Effectively, trimpot VR1 provides a

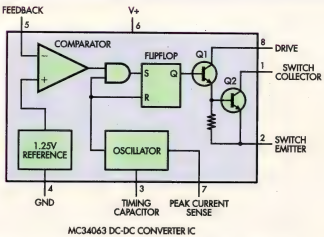


Fig.1: inside the MC34063 DC-DC Converter IC. It contains the circuitry to build a step-up, step-down or inverting switching regulator.

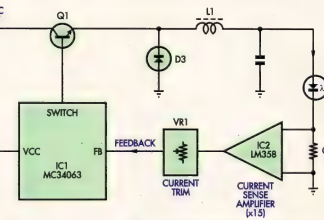


Fig.2: the basic block diagram of the step-down switching regulator section. A fraction of the input voltage is transferred to the output under control of an MC34063 switching regulator IC. The LED current is regulated by sensing the voltage drop across a small series resistance (R1).

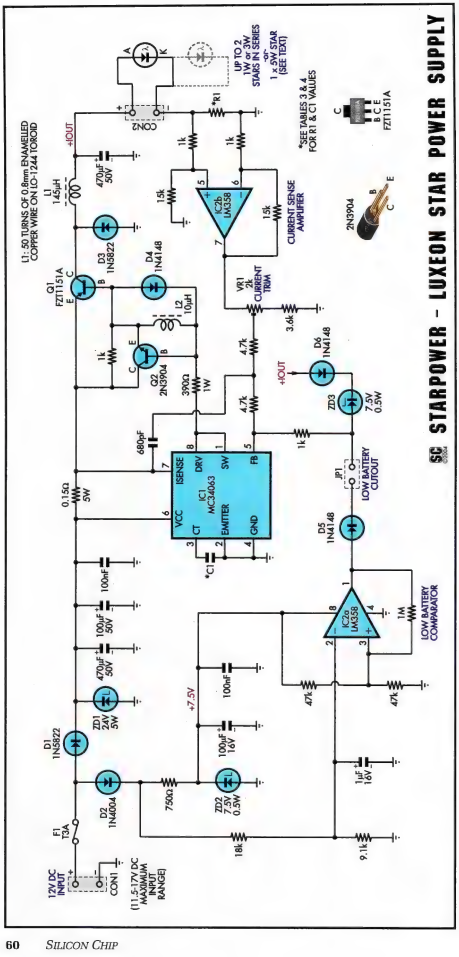


Fig.3: the complete circuit diagram for the power supply module. A low VCE_{SAT} transistor (Q1) is used for the switching circuit to minimise heat dissipation and improve efficiency. Output current is selectable in three ranges by choosing an appropriate value for R1.

means of adjusting the voltage drop across R1. As the wiper is moved towards the top (clockwise), less voltage is required across R1 to satisfy the feedback loop, so the output current decreases. The opposite occurs when the wiper is moved downwards, attenuating the op amp's output and thus increasing the output current.

During construction, R1 is selected from Table 3 to suit the desired LED current. These values were chosen such that close to 100mV will be present across the resistor at the listed LED current level. It's then just a matter of adjusting VR1 to get the precise current level.

To reduce harmonics in the switching circuit, a novel scheme is used to "feed forward" a small portion of the switching signal into the feedback circuit. This is achieved with a 680pF capacitor between the ISENSE and FB pins.

Low battery cutout

IC2a is used as a simple voltage comparator for the low battery cutout circuit. It works as follows.

Zener diode ZD2 provides a clean +7.5V supply for this op amp. This 7.5V rail is also divided in half by two 47kΩ resistors and to provide a reference voltage for the comparator on pin 3. Similarly, the power supply input voltage is divided down by 18kΩ and 9.1kΩ resistors and applied to the negative input (pin 2).

When the voltage on pin 2 falls below that on pin 3 (corresponding to less than 11.5V at the supply input), the output swings towards the positive rail, forcing IC1's feedback input above the 1.25V set point. This stops IC1 from switching and reduces the input current drain to quiescent levels (less than 10mA).

A 1MΩ resistor between the op amp output (pin 1) and its positive input ensures fast switching and provides a few hundred millivolts of hysteresis. In addition, a 1µF capacitor at the inverting input filters out any momentary transients and ensures that

Parts List

1 PC board, code 11105041, 105mm x 60mm
1 powered iron toroid, 28 x 14 x 11mm (L1) (Jaycar LO-1244)
170cm (approx) 0.8mm enamelled copper wire
1 10µH RF choke (Altronics L-7022, Jaycar LF-1522)
2 2-way 5mm (or 5.08mm) terminal blocks (CON1, CON2)
1 2-way 2.54mm SIL header (JP1)
1 jumper shunt (JP1)
1 8-pin IC socket
2 M205 PC mount fuse clips
1 M205 3A slow blow fuse
4 M3 x 10mm tapped spacers
4 M3 x 6mm pan head screws
2 small cable ties
1 heatsink for 3W or 5W LEDs (see text)
1 2kΩ miniature horizontal trimpot (VR1)

Semiconductors

1 MC34063 DC-DC converter (IC1)
1 LM358 dual op-amp (IC2)
1 FZT1151A PNP transistor (Q1) (Farnell 935-499)
1 2N3904 NPN transistor (Q2)
2 1N5822 Schottky diodes (D1, D3)
1 1N4004 diode (D2)
3 1N4148 small signal diodes (D4 - D6)
1 24V 5W zener diode (ZD1)
2 7.5V 0.5W (or 1W) zener diodes (ZD2, ZD3)
1 or 2 1W or 3W Luxeon Star LEDs; or 1 5W Luxeon Star LED (see text)

Capacitors

2 470µF 50V low-ESR PC electrolytic (Altronics R-6167)
1 100µF 50V low-ESR PC electrolytic (Altronics R-6127)
1 100µF 16V PC electrolytic
1 1µF 16V PC electrolytic
2 100nF 50V monolithic ceramic
1 1.2nF 50V ceramic disc (or polyester)
2 680pF 50V ceramic disc
1 560pF 50V ceramic disc
1 330pF 50V ceramic disc

Resistors (0.25W 1%)

1 1MΩ 2 4.7kΩ
2 47kΩ 1 3.6kΩ
1 18kΩ 4 1kΩ
2 15kΩ 1 750Ω
1 9.1kΩ 1 390Ω 1W 5%
2 0.15Ω 5W (or 3W) 5% (Farnell 347-2693)
1 0.1Ω 5W (or 3W) 5%
1 0.27Ω 5W (or 3W) 5%

Additional resistors for testing

1 10Ω 5W 5% (350mA test)
1 4.7Ω 5W 5% (700mA test)
1 3.3Ω 5W 5% (1000mA test)

Note: parts shown with a Farnell catalog number can be ordered on-line direct from Farnell at **www.farnellinone.com.au** or phone 1300 361 005. The 0.15Ω 5W resistors are also available from WES Components, phone (02) 9797 9866.

the negative input remains below the positive input during power up.

Note that despite this filtering, the LED will flash momentarily at power on and power off. This is because unlike the LM358 op amp, the MC34063 operates right down to 3V.

Finally, a series diode (D10) and 7.5V zener diode (ZD3) connected between the output and the feedback circuits prevents the output voltage rising much above 9V if the LED is inadvertently disconnected. This helps to reduce the peak current flow that occurs if the output is reconnected with power applied.

Construction

The assembly is straightforward, with all the parts mounted on a PC board coded 11105041 and measuring 105 x 60mm. The parts are all installed on the board in the conventional manner except for switching transistor Q1, a surface-mount (SMT) device which is installed on the copper side.

The first job is to mount Q1. Although this is an SMT device, it has relatively large pins with ample spacing that are easy to solder.

To install it, place the copper side of the board up and position Q1 precisely as shown on the overlay diagram (Fig.6) before soldering the leads.

With Q1 in place, turn the board over and install the two wire links using 0.7mm tinned copper wire or similar. One of the links (shown dotted) goes underneath IC2, so it's important that it goes in first!

Next, install all the low-profile components, starting with the 0.25W resistors and diodes. All the diodes, including the zeners, are polarised devices and are installed with their banded ends oriented as shown.

An IC socket can be installed for IC2. However, IC1 should be soldered directly to the board (no socket!) to eliminate the effects of contact resistance. Be sure to align the notched (pin 1) ends as indicated.

All remaining components can now be installed except for the electrolytic capacitors. It's easier to leave these until after the inductor (L1) is in place.

Select appropriate values for C1 & R1 from Tables 3 & 4. It's very impor-

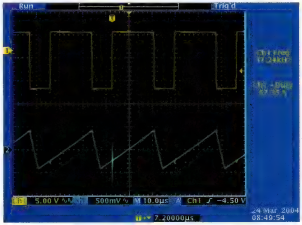
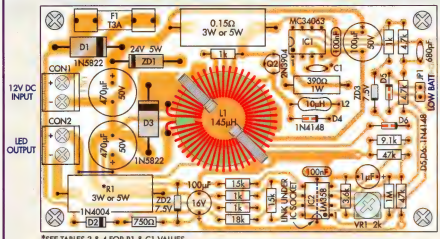


Fig.4: this scope shot shows the switching waveform present on the cathode of D3 (top trace) versus the MC34063's on-board oscillator on pin 3 (bottom trace). Note that the switching frequency will vary significantly according to LED type and number and will not necessarily equal the oscillator frequency.



*SEE TABLES 3 & 4 FOR R1 & C1 VALUES

Fig.5: follow this layout diagram when installing the parts on the PC board and don't forget the link under IC2.

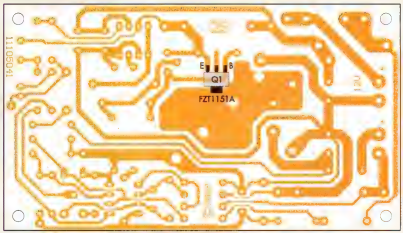


Fig.6: the mounting details for transistor Q1. It's soldered on the copper side of the board using a fine-tipped soldering iron.

tant that these match your intended application (type of LED and one or two LEDs in series). The parts list includes all of these parts, so you will have an extra three ceramic capacitors and two 5W (or 3W) resistors left over once assembly is complete.

Winding the inductor

The inductor (L1) must be hand-wound using the specified toroidal core and about 170cm of 0.8mm enamelled copper wire. Play out the wire into a straight length, removing any kinks before you begin.

It's easier to wind one half at a time, so start by feeding about half of the wire through the centre of the core. Wind on the first half using firm even tension and keep the turns as close as possible without overlapping.

Now repeat this procedure with the second half of the wire. In total, the core will accommodate 50 turns if there are no gaps between adjacent turns on the inside of the core.

Now count the total number of turns. With a bit of luck, you should have 49 or 50 (one less is OK!). Trim and fashion the ends of the wire so that the assembly slips home easily into the holes in the PC board with a few millimetres protruding out the opposite side.

Next, scrape the enamel off the ends of the wire, tin them and reposition the inductor on the PC board. Don't solder the wires just yet though. It's important to first attach the inductor to the board using small cable ties. Position the inductor so that it is well clear of surrounding components before tightening up the ties. That done, solder and trim the wire ends.

Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
100nF	0.1µF	104	100n
1.2nF	.0012µF	122	1n2
680pF	–	681	680p
560pF	–	561	560p
330pF	–	331	330p

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	1MΩ	brown black green brown	brown black black yellow brown
2	47kΩ	yellow violet orange brown	yellow violet black red brown
1	18kΩ	brown grey orange brown	brown grey black red brown
2	15kΩ	brown green orange brown	brown green black red brown
1	9.1kΩ	white brown red brown	white brown black brown brown
2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
1	3.6kΩ	orange blue red brown	orange blue black brown brown
4	1kΩ	brown black red brown	brown black black brown brown
1	750Ω	violet green brown brown	violet green black black brown
1	390Ω 5%	orange white brown gold	not applicable

Finally, install all the electrolytic capacitors to complete the job. Take particular care with orientation – their positive leads must go in as indicated by the "+" markings on the overlay diagram.

Setup & testing

Before connecting an LED to the output for the first time, the supply should be checked for correct operation. During the test, we'll also set the output current to an initial value to suit the type of LEDs being used.

The test involves inserting a 5W test resistor in the LED output terminals. The resistor value to use depends on the output current level selected during assembly. For 350mA of current, use a 10Ω test resistor, for 700mA a 4.7Ω value and 1000mA a 3.3Ω value.

Don't cut the resistor leads short. It should be screwed into the LED output terminal block and suspended in mid-air, such that it's not in contact with anything; it will get very hot! With this in mind, the circuit should not be powered up for more than a few minutes with the test resistor in place.

Remove the jumper shunt on JP1 if you installed it earlier and rotate VR1 fully clockwise. Connect a 12V DC (1A or higher) power source to the input terminals and power up. Monitor the voltage across R1 (not the test resistor) with your multimeter and adjust VR1 to get the desired current level. The correct sense voltage for each current level is listed in Table 3.

For example, if you want 700mA for a 3W LED, you will have installed a 0.15Ω resistor for R1, so adjust VR1 to get a 105mV reading on your meter.

If all checks out, you're almost ready to go. Remove the test resistor and replace it with the LED leads. Power up again and check that the voltage across R1 is as previously set. If necessary, readjust VR1 to get the listed reading.

Note: the light output from these LEDs could damage your eyesight. Do not stare directly into the LED beam at close range!

If you have a variable DC bench supply, you can also test the low battery cutout circuit by slowly reducing the input voltage. At about 11.5V, the LED should switch off. Remember to install the jumper shunt on JP1 to enable this function.

Note: in a quiet environment, you may be able to hear a low level "squeal" coming from the inductor (L1). This is completely normal and is due to the harmonics caused by the gated oscillator architecture of the MC34063 switching regulator IC.

Fault-finding

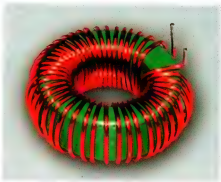
If your meter reads way off the mark and/or adjusting VR1 has no effect, then there is a fault on the board. Switch off and remove the test resistor, then power up again with nothing connected to the output.

With your meter set to read volts, first measure between pins 1 & 8 of IC2. These are the op amp supply pins, so you should get close to 7.5V. If not, look for problems around ZD2 and its associated circuitry.

Next, measure between pins 6 & 4 of IC1. Again, these are the supply pins of the IC but this time, expect about 0.3V less than the input voltage.

If you have an oscilloscope, you can check that the oscillator in the MC34063 is working by examining the waveform on pin 3. You should see a clean sawtooth waveform like that shown in Fig.4.

Assuming the above measurements are OK, then it's back to basics. Examine the board closely for correct component placement and soldering defects, especially around IC1, IC2 and the 100µF 16V capacitor. It's easy to



Bend and shape the ends of the winding so that the assembly slips easily into the holes in the PC board. This shot of the underside of L1 shows the general idea, although this core doesn't have the full 50 turns!

This larger-than-life size view shows how transistor Q1 is mounted on the underside of the PC board.

Table 3: Selecting Resistor R1

LED Type	LED Current	R1	Sense Voltage
1W Star	350mA	0.27Ω	94.5mV
3W Star	700mA	0.15Ω	105mV
3W Star	1000mA	0.1Ω	100mV
5W Star	700mA	0.15Ω	105mV

Table 4: Selecting Capacitor C1

LED Type	No. of LEDs in Series	Colour	C1
1W Star	1	Red, Red-Orange, Amber	330pF
1W Star	2	Red, Red-Orange, Amber	680pF
1W Star	1	White, Green, Cyan, Blue, Royal Blue	560pF
1W Star	2	White, Green, Cyan, Blue, Royal Blue	1.2nF
3W Star	1	All	560pF
3W Star	2	All	1.2nF
5W Star	1	All	1.2nF

Where To Get Luxeon Stars

Luxeon Star LEDs and the heatsinks mentioned in the text can be purchased from one or more of the following sources:

(1). Alternative Technology Association, phone (03) 9388 9311, **www.ata.org.au**

(2). Altronics, phone 1300 780 999, **www.altronics.com.au**

(3). Jaycar Electronics, phone 1800 022 888, **www.jaycar.com.au**

(4). Oatley Electronics, phone (02) 9584 3563, **www.oatleye.com**

(5). Prime Electronics, phone (02) 9746 1211, **www.prime-electronics.com.au**

Detailed technical information on Luxeon Star LEDs can be obtained from the Lumileds web site at **www.lumileds.com**

A heatsink intended for one of the later model processors (such as the AMD Athlon) would be more suitable in high ambient temperatures and will extend LED life. Simply remove and discard the fan & retaining clip before drilling the mounting holes. Recycled heatsinks may have an old sticky heat transfer pad in the centre, which must be removed with solvent before attaching your LED.

get solder bridges between the closely spaced tracks in these areas.

Mounting & wiring

The completed power supply module can be mounted without an enclosure if a protected location is available. Alternatively, it can be housed in a UB3-sized "Jiffy" box for ruggedness. Jaycar Electronics has a range of flanged ABS boxes that would be ideal for the job.

For marine applications, the entire assembly will need to be conformally coated or installed in a sealed enclosure to keep corrosion at bay.

The power input and LED output wiring must be run using heavy-duty (7.5A) cable. We recommend no more than about 25cm of cable length between the power supply output and the LEDs.

Keeping your LEDs cool

This project can be used to power any of the 1W, 3W or 5W Luxeon Star range. Out of these, the 1W version is by far the easiest to use because of its relaxed heatsinking requirements.

In fact, when operated in low ambient temperatures, no additional heatsinking is necessary for versions with board mounted optics (Star/O).

However, in most real-world applications, a small heatsink will help to keep the LED junction temperature within specs, as well as prevent heat damage to the acrylic lens. This can often be as simple as a flat metal panel or the lid of a metal case, for example.

Unlike the 1W types, the 3W & 5W Stars require careful attention to heatsinking, particularly when reliability and long service life are important. Despite this requirement, the excellent "lumens per buck" rating of the new 3W Stars definitely makes them worth a look. So how is the heatsink size determined? Let's find out!

Heatsink basics

As with any power semiconductor device, we can calculate the required heatsink thermal resistance once we know the maximum junction temperature, ambient temperature and power dissipated.

As only about 10% of the input power to the LED is emitted as light, it is disregarded in the following calculations. Assuming a nominal LED forward voltage of 3.6V, power dissipation can be found using Ohms law:

$$P_D = V/I = 3.6V/1A = 3.6W$$

Using the absolute maximum LED junction temperature of 135°C and an ambient temperature of 25°C, the junction to ambient thermal resistance is:

$$RTH_{J\text{-}A} = T_J - T_A / P_D$$
$$= 135°C - 25°C / 3.6W$$
$$= 30.5°C/W$$

Next, subtract the junction to board resistance ($RTH_{J\text{-}B}$) listed in the datasheet to find the board to ambient thermal resistance. For most board-mounted Stars, this is 17°C/W:

$$RTH_{B\text{-}A} = RTH_{J\text{-}A} - RTH_{J\text{-}B}$$
$$= 30.5°C/W - 17°C/W$$
$$= 13.5°C/W$$

The result is the maximum allowable heatsink resistance needed to keep the LED junction temperature at or below the maximum rating at 25°C ambient.

The 48 x 48mm finned heatsink shown in the adjacent photo was originally designed for cooling Intel 486 and Motorola 68000 series microprocessors but works equally well

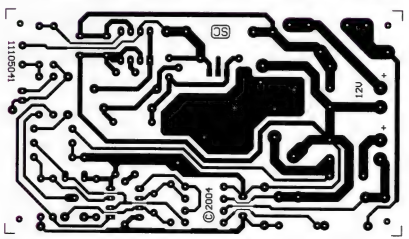


Fig.7: this is the full-size etching pattern for the PC board.

here. According to our rough calculations, it has a thermal resistance of about 8°C/W when operated in free air in the vertical position.

So far, we've assumed operation up to the maximum LED junction temperature of 135°C. However, when operated continuously at this maximum, LED light output decreases quite markedly over time. To achieve the 20,000 hours at 50% lumen maintenance figure shown in the datasheets, Lumileds specifies a lower maximum junction temperature of 90°C.

Reworking the figures for this lower temperature, you can see that a heatsink resistance of 1°C/W would be required. This would be difficult to implement in practice, necessitating a bulky heatsink, perhaps even with forced-air cooling.

For maximum life with a realistic heatsink size, the answer is to drive the LEDs at reduced current. For this reason, Lumileds also characterises the 3W Star for operation at 700mA, stating lumen maintenance of 70% after 50,000 hours at the lower temperature figure.

The maximum heatsink resistance needed in this case is 8.8°C/W at 25°C ambient, meaning our chosen heatsink barely makes the grade. If operation in the horizontal position is required or higher ambient temperatures are likely, then a lower resistance heatsink will be needed.

The above information is also applicable to the 5W Star, although it's life versus junction temperature figures are radically different to the 3W version. Note also that it's rated for a maximum of 700mA forward current and has a higher forward voltage than the 3W device. Refer to the individual device datasheets for more information.

To learn all about heatsinking, check out the "Thermal Design using Luxeon Power Light Sources" application brief, available from the Lumileds website at **www.lumileds.com**. **SC**

We mounted our 3W Star on a 48mm square heatsink pinched from an old 486 motherboard. Drill two 3mm mounting holes in line with the slot between the fins and then deburr the holes to obtain a smooth mounting surface. A thin smear of heatsink compound between surfaces will aid heat transfer. You'll need to use nylon washers under the heads of the screws to prevent short circuits to the solder pads on the Star PC board. Don't be tempted to run the 3W or 5W Stars without a heatsink – they'll quickly self-destruct! Wide, narrow and elliptical beam lenses similar to that shown here can be fitted to suit most applications.

Wireless Parallel Port

Low-cost design uses a 434MHz UHF data link

Incorporating a UHF data link, this Wireless Parallel Port is just the shot for computer control of irrigation systems, solenoids, robots, lights or just about anything. It's based on pre-built UHF radio modules and is low in cost.

By NENAD STOJADINOVIC

THE NOVEMBER 2003 issue of SILICON CHIP included an article entitled "Smart Radio Modem for Microcontrollers". This was basically a low-cost data link that could send up to 16 bytes of data at a time across the radio "ether" over a range of 150-200 metres.

The project described here expands on that basic concept by serving up the received data in parallel format. This makes it much easier for the novice to use and opens up a world of applications that were designed for the parallel port.

Fig.1 shows the basic scheme for the Wireless Parallel Port. It's based on a transmitter and receiver pair using Laipac brand 433.92MHz UHF modules, with PIC microcontrollers handling the "smarts".

As shown in Fig.1, the transmitter is exactly the same as used for the Smart Radio Modem. For those who haven't seen it before, the modem transmitter can be driven by any microcontroller such as a PICAXE, Stamp, etc. Alternatively, it can be attached to a computer COM port via an RS232-TTL adapter (also described in the November 2003 issue) and will accept the download of up to 16 bytes of data at a time.

The downloaded data bytes are subsequently sent on their way by simply pulling the transmitter's SEND pin low for a short period (eg, 0.25s). The modem receiver then outputs the data, giving the effect of a serial cable that can be up to 200m long.

The parallel port receiver differs slightly in that it only receives and then outputs one byte of data per transmission. This data byte is latched on the output pins until the next byte comes along.

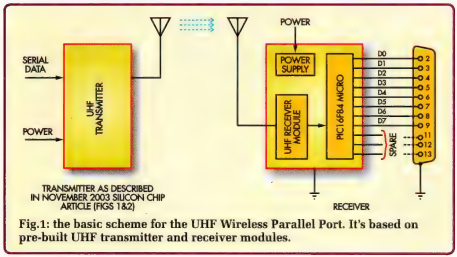


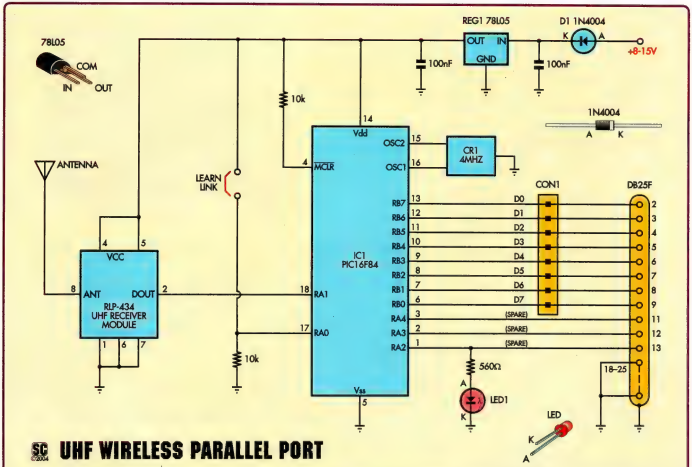
Fig.1: the basic scheme for the UHF Wireless Parallel Port. It's based on pre-built UHF transmitter and receiver modules.

Basic functions

We will assume here that you have read the November 2003 article, so we won't cover the same material again. If you don't have a copy, it is available as a back issue for $8.80 (including postage).

Basically, this unit is designed to be as easy to use as possible. For example, to transmit data to the Wireless Parallel Port using a communications program such as Hyperterminal, you simply send the number of the receiver pin that you want to turn on (ie, raise to +5V or logic "high"). You then briefly pull the SEND pin low on the transmitter module.

Unfortunately, Hyperterminal (which comes standard with Windows) will not allow you to directly control the SEND pin (connected to the COM port's RTS line), so using it requires a pushbutton switch between the SEND pin and ground. As a result, it's more



UHF WIRELESS PARALLEL PORT

Fig.2: this is the complete circuit for the receiving end of the UHF Wireless Parallel Port. PIC microcontroller IC1 receives data from the UHF receiver, decodes it and outputs the data (D0-D7) to pins 2-9 of a DB25F connector. LED1 flashes to indicate when data is being received.

convenient to use a COM port test program which can drive the port directly. I use "Simple Term" which is available from **www.ptronix.com**. This program allows you to load the data, toggle the SEND (RTS) pin and watch the BUSY (DSR) pin all from the comfort of the computer screen – very convenient.

Thus, to turn on pins 3, 4 & 5, you simply type in 345 (ie, no spaces) and toggle the SEND pin. In Simple Term, you type 345 in the blue bar, click Send and then change the RTS radio button to light green and back to dark. Sending 128 (for example) would then turn off the above pins and turn on pins 1, 2 & 8. Sending "0" turns all the pins off.

Using a password

The ability to use a password is a useful option with this unit and there are a couple of reasons why you might want to do this. If your neighbour has a similar unit, for example, the use of a password will prevent interference between them. Alternatively, you might want to have a number of receivers, each responding to its own password.

The password allowed is rudimentary. It simply consists of a single character but it does give you up to 256 different choices.

To load a password, you simply type in "P" (without the quotes) and then the password; eg, P*. Note that you must use a capital P and the "learn link" must be in place on the board during this procedure – see Fig.2. Once that's done, the receiver will only respond to commands prefaced by the password; eg, *145.

To remove the password, just send the character "X" with the learn link in place.

For advanced users

Sending a byte to switch each of the pins is all very well but it can also be very useful to simply send a single byte that will be transferred to the port as binary data.

To do this, simply send the "B" command followed by the binary data. Thus, B<01h> will set the port's D0 pin high. Similarly, B<FFh> will set them all high. This function works in conjunction with a password if you have one in place.

Circuit details

The complete receiver circuit is shown in Fig 2. Apart from the UHF receiver module, it uses a PIC16F84 microcontroller (IC1) and a few other bits and pieces.

The circuit essentially emulates a parallel port and outputs its data to D0-D7 (these are pins 2-9 on a standard DB25 connector). Pins 11, 12 & 13 of the DB25 connector are also connected to the microcontroller and may be used in future projects. In addition, an RX (received) data indicator is fitted, consisting of a LED connected to pin 13 via a 560Ω resistor. This LED lights

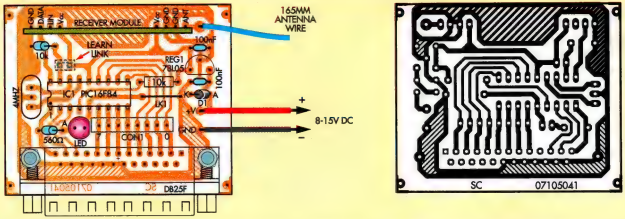


Fig.3: the PC board should only take you 30 minutes to assemble. Take care to ensure that the receiver module is correctly oriented – see photo. The PC board pattern at right is shown full size.

and the pin goes high briefly when ever a valid data transmission has been received.

The previously mentioned "learn link" is connected to pin 17 (RA0) of IC1. Fitting this link pulls pin 17 high (it's normally pulled low via a 10kΩ resistor) and places the microcontroller in the "learn" mode.

Parts List

1 PC board, code 07105041, 60 x 60mm
1 4MHz 3-pin ceramic resonator (CR1)
1 DB25 female PC-mount connector
1 18-pin IC socket
1 2-way connector
1 2-pin SIL header plus jumper shunt
1 8-pin straight SIL header
1165mm length of light-duty hookup wire

Semiconductors
1 Laipac RLP-434 UHF receiver module
1 PIC16F84 programmed microcontroller (IC1)
1 1N4004 diode (D1)
1 5mm LED (LED1)
1 78L05 voltage regulator (REG1)

Capacitors
2 0.1µF monolithic

Resistors (0.25W, 1%)
2 10kΩ
1 560Ω

All outputs to the port can be monitored via connector CON1, while a 4MHz ceramic resonator (CR1) provides the clock signals.

The unit can be powered by an DC supply from 8-15V (eg, a plugpack). Diode D1 provides reverse polarity protection, while regulator REG1 provides a stable +5V rail to power IC1 and the UHF receiver module.

Construction & testing

With only a handful of components, the construction is not challenging. Fig.3 shows where all the parts go. Install the smallest components first and watch the orientation of everything except the resistors.

Don't forget the wire link and be sure to use a socket for IC1. Note that the UHF receiver module is installed with its red coil facing towards IC1 – see photo. The antenna consists simply of a 165mm length of insulated hookup wire.

If you are using the receiver to control a board (eg, a relay board) that doesn't have its own power supply, you will need to organise power to both. The DB25 connector is tied to ground, so you will probably only need to connect a positive lead from one board to the other.

If you have any doubts about how it all goes together, you can leave out the PIC and the UHF receiver module until the power supply is sorted out. That way, they cannot be damaged if you make a mistake.

In fact, it's a good idea to check that there is +5V on pin 14 of IC1's socket before switching off the power and installing the microcontroller and the receiver module.

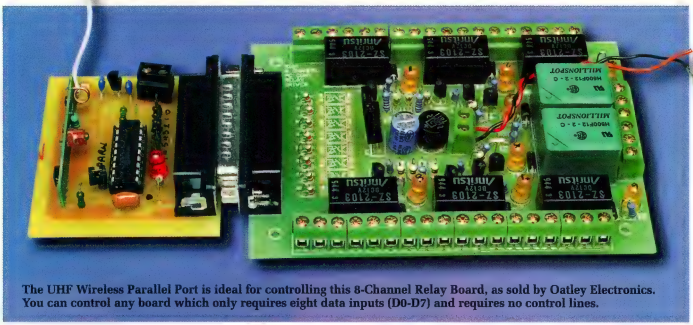
Testing simply involves sending data to the receiver and checking that the LED blinks. You can then check which pins have been set (ie, taken high) by using a multimeter to measure the voltages on CON1.

Practical applications

The accompanying photo shows the receiver connected to an 8-channel relay board, as sold by Oatley Electronics (see SILICON CHIP, September 2000). Basically, you can use any board which only requires eight data inputs (D0-D7) and requires no control lines.

With six standard and two heavy duty relays, driving just about any load is no problem and password activation means you can selectively drive up to 256 separate relay boards.

This view shows the transmitter board plugged into its companion RS232 interface board (see SC, Nov. 2003).



The UHF Wireless Parallel Port is ideal for controlling this 8-Channel Relay Board, as sold by Oatley Electronics. You can control any board which only requires eight data inputs (D0-D7) and requires no control lines.

That's a lot of relays!

I've been using these boards in the garden to control irrigation solenoids and currently the back and front yards have one each, controlled by their own password. I had what is essentially a PIC-based alarm clock left over from another project and I simply set the start and stop times during the day for each relay. For example, in pseudo code:

At 10:35 am:
Send "1 ;Turn on relay 1 on card with the password """*
At 11:20 am:
Send "0 ;Turn off all relays on card with the password """*

I imagine that this would be a very simple program for the PC, perhaps with a scheduling grid to show what is on and off at what time. **SC**

Where To Get The Parts

Kits plus individual parts for this project are available from the author. Prices are as follows (kit prices include the PC board plus on-board parts only):

(1). Wireless Parallel Port Receiver $46.00
(2). Matching Transmitter Kit $28.00
(3). Transmitter/Receiver Kit Package Deal $69.00
(4). RS232 Interface Kit For Transmitter $25.00
(5). Programmed Microcontroller With Resonator ..... Rx $18.00; Tx $15.00
(6). Rubber Duck Antenna (see November 2003 article) ..... $19.00 each

All prices include postage within Australia and GST. To order, write or email the author as follows:

Nenad Stojadinovic, PO Box 320, Woden, ACT 2606.
email: vladimir@u030.aone.net.au

The Laipac UHF transmitter and receiver modules are also available from Commlinx Solutions at **www.commlinx.com.au**

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Are your SILICON CHIP copies getting damaged or dog-eared just lying around in a cupboard or on a shelf? Can you find that particular issue you need to refer to?

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If not, register online at www.altronics.com.au/ and we will send you a ***FREE*** copy as soon as humanly possible! Or request a catalogue when you place your order on our mail order hotline: **1300 797 007**. The ALL NEW Altronics 20th Edition catalogue is 308 pages ***CHOCK-A-BLOCK*** with fantastic products & info. Featuring ***Over 1500*** new and exciting items added to the range for 2004!

Why pay a security company to install an alarm?

DO IT YOURSELF AND SAVE A FORTUNE! Protecting your home & family in the process

This revolutionary alarm system features unique "2 wire" technology which cuts installation time in half! (Just about anyone could install & program this system in HALF A DAY!) This pack has everything you need to secure your home: Alarm panel, siren, strobe, 4 reed switches and 2 PIR sensors, plugpack, 50m of cable. And just because its simple, doesn't mean it lacks features; • Entry/exit delay • 4 zone monitoring • Tamper protection • Battery backup • User defined PIN code • PIRs use pulse count triggering to reduce false alarms • Panic function • Door chime

Excellent alarm for home units, flats, villas or office suites. It's also versatile enough for small business or workshops!

NEW $249 S 5136

Measure any distance at the press of a button!

NEW

With this fantastic digital ultrasonic tape measure you can measure distances in an ***INSTANT!*** High accuracy and super easy operation makes it perfect for builders, installers etc. A handy built in laser allows you to see exactly what you're measuring! Max distance 13m.

A must have for installers, builders or consultants!

$44.95 T 2250

INSPECT-A-GADGET

NO MORE EYE STRAIN!

Let "gadget" be your eyes! Identify those impossible to read miniature components, without straining your eyes. Great for stamp and coin collectors, model makers, seamstresses, jewellers etc. ***WITH 3 DIOPTER MAGNIFICATION!***

Features an ultra-bright Philips® triphosphor fluorescent tube for extra crisp, clear view!

$109 A 0970A

Stainless Steel Tools

NEW

RUST PROOF!

High grade stainless pliers and cutters. WILL LAST FOR YEARS! Normally $15.95ea T 2754S

BUY BOTH FOR $25

Recreate cinema sound in your lounge...

WITH THIS ACTIVE SUBWOOFER!

This fantastic subwoofer will add mind blowing realism to your home theatre system. This sub features a 160W 10 inch driver with built in amplifier rated at 0.1% THD. A stunning frequency response of 35Hz-1KHz. • level control • crossover adjustment • phase reversal switch. **SAVE $40!** **Additional freight charge applicable if outside Capital Cities.*

$309* RRP $349 C 5200

INSTALLS IN MINUTES! NO EXPERTISE REQUIRED

MASSIVE BASS TO RATTLE YOUR FLOORBOARDS!

Identify & test components in SECONDS!

An incredibly versatile piece of test equipment that will save you HOURS in looking up transistor, diode and FET specifications. Great for R&D, servicing technicians, engineers etc. Instantly provides info on:

- Diodes • Bipolar transistors • MOSFETS • JFETS • SCR's & Triacs
- LEDS • Thyristors and more!

AMAZINGLY EASY TO USE!

$299 Q 2100

"Walkie Talkie" 2 Way Radios!

GREAT PRICE!

Stay in touch with your mates up to 8KM away - **FOR FREE!**

No licence required Perfect handheld radio for recreation, building sites, 4WDs, hikers, campers etc. **X 0520:** 40Ch UHF with CTCSS & VOX **0.5W** **X 0540:** 40Ch UHF with VOX **1.5W** ***High Power!***

Features: • Backlit LCD • Channel scan • Call tone • Battery indicator • Dual channel monitor • VOX operation for use with headsets • Repeater mode. Requires 4 x AAA batteries. • **S 4742B** 2 x AAA Pack $9.95 • **X 0501** Headset $14.95 • **X 0502** Charger $14.95

$79.95 X 0520 $119 X 0540

STARTER PACK SAVER: ***Buy either the X 0520 or X 0540, and you get 4 x AAA rechargeable batteries and a charger for just $10 extra! SAVE $24.85!***

"Under carpet" Flat Cable

$70* W 2980

Great for discrete custom installs! BUY A 50M ROLL AND SAVE!

THE EASY WAY TO WIRE UP HOME THEATRE SYSTEMS AND CAR AUDIO INSTALLS!

MINDBLOWING Studio Headphones!

BRAND NAME QUALITY SOUND FOR A FRACTION OF THE PRICE!

We were absolutely AMAZED when we evaluated these headphones, they sound simply AWESOME! Deep bass with crisp treble and full midtones.

For those who demand a high quality listening experience!

Features rare earth Neodymium magnets for superior sound!

$99 C 9014

Every workshop needs one!

WITH FREE GLUE!

A great tool for both home or workshop. Use it to glue together wood, plastics, paper, cardboard and ceramics. Very simple to use.

$17.95 T 2940S

BONUS PACK! Purchase a T 2940 and receive 2 packs of small glue sticks (12 pcs) valued at $5.90 ABSOLUTELY FREE!

Engrave, Drill, Cut, Trim & Grind!

This fantastic hobbyist drill kit comes supplied with four grinding bits, cutting disc, four chucks (0.5, 1.5, 2.4, 3mm), 5 PCB drills (0.5, 0.8, 1, 1.2 and 1.5mm) and plugpack. It's lightweight yet torquey enough to handle the really tough jobs!

Great for drilling and trimming PCBs, engraving, model making, custom instrument panel work etc.

$59.95 T 2301

All supplied in a tough plastic carry case!

DATALOGGING RS232 METER

PRICE BREAKTHROUGH!

Under $100 for a meter featuring **optically isolated** RS232 connection and software! Great for analysing battery chargers, timed circuits or many other variables! **Feature packed!:** • DCV to 1000V • ACV to 750V • DC A to 10A • Resistance to 40MΩ • Capacitance to 100µf • Continuity • Frequency to 40MHz • Duty cycle • Diode test • Auto power off • Rubber holster, test leads & software included. • Data hold

Software allows datalogging with variable sampling time, data storage, plus graph output!

$99 Q 1078

Switch AV inputs easily

NEW

3 Way AV switcher with both RCA and S-Video input/outputs. *NO POWER SUPPLY REQUIRED!*

$19.95 A 3058

NEW! LONG NOZZLE TYPE! The perfect barbie lighter.

Pocket Rocket Blowtorches!

NEW

They may be small but they pack a ***mean*** punch! One flick of the trigger and you have a whopping 1300°C flame ready for brazing, heavy duty soldering or heatshrinking. Featuring: • One handed operation • Safety ignition lock • Refillable gas cartridge • Compact size.

$26.95 T 2491 Long Type

$19 RRP $24.95 T 2490

Perfect for those quick jobs!

COMPETITION GRADE SUBS!

Why pay a fortune for some overpriced brand name subs? *In our opinion these sound just as good but without the inflated price!* Kevlar impregnated pulp cone for efficiency and strength. High temp Kapton™ voicecoil with 4 layer winding for incredible sound reproduc-

NEW 1000W 15" MONSTER!

Pictures do not do this speaker justice, it is simply AWESOME in both looks and sound. It features a HUGE **6kg double stack magnet.** True competition grade sub!

$129 or 2 up $110ea C 3049 4Ω 10" 500W

$159 or 2 up $135ea C 3051 4Ω 12" 600W

$279 or 2 up $225ea C 3053 4Ω 15" 1000W

■ EXPRESS ORDER HOTLINE
1-300 797 007

■ FAX
1-300 789 777

■ EXPRESS
Overnight Delivery!*

■ NO RISK - MONEY BACK
14 day guarantee†

60W Soldering Stations

RRP $149
$199
T 2442 916

RRP $249
T 2390 SMD

Includes a high quality Japanese ceramic heating element!

Fantastic everyday iron! Available in standard or SMD ceramic model. Ideal for service techs, engineers or production work. **Features:** • Ceramic heating element • Heater insulation of over 100MΩ • Zero voltage circuit prevents damage to components • Temp adjustable from 250° to 450°C

NEW Keyring LED torches

Great for finding keyholes in the dark! **7 types available in 6 different colours!** Batteries included.

$12.95
X 0189 UV
X 0191 Blu
X 0192 Wht
X 0193 Grn

$9.95
X 0190 Red
X 0194 Ylw

$18.95
Aluminium
X 0168

Great gift idea! Pick one up for Mum!

28 RANGE PRO Multimeter WITH JUMBO DISPLAY

INCLUDES TEMP PROBE!

Easy to read display and massive 20A current range make this meter an excellent choice for the servicing, R&D and everyday testing. Onscreen prompts ensure you never insert leads incorrectly again! **PACKED WITH FEATURES:** • ACV &DCV to 1000V • **Massive 20A rating (AC or DC)** • Resistance to 20MΩ • Capacitance to 100µF • Temp to 1000°C • Continuity • Frequency to 20kHz • Diode test • Auto power off • Rubber holster & test leads included. • Data hold

$79
Q 1067

NEW

240V Mains power from a 12V car battery

RRP $85
$99
M 9103 150W

RRP $149
M 9112 250W

RRP $349
M 8132 750W

Laptops, portable hi-fi's.

Battery chargers, portable TV's.

Power tools, lighting, small pumps, drills, angle grinders.

• **Mains power to your appliances anywhere, anytime.** • Powered from a 12V battery • Fantastic for mobile tradesmen, farmers, camping and recreation!

Keep your gear powered up, even on the road! Great for cars, vans, boats, caravans etc.

8 in 1 Remote

Sick of losing your remotes under the couch? Well **COMBINE THEM ALL** into this single slimline learning remote control. Features 32 storage keys for each device. *WITH HANDY MACRO KEY!*

$45
RRP $59
A 1008

Lockable Ally Cases!

Rugged aluminium construction.
T 5000A: 460 x 325 x 150mm
T 5000: 330 x 230 x 90mm
T 5010: 430 x 245 x 175mm
HOLDS APPROX 60 CD's!

$39
Custom
T 5000

$79.95
CD Case
T 5010

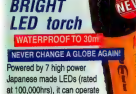
$44
RRP $49
T 5020A

Beware of inferior quality cheaper models on the market which have plastic sides and are less robust.

Fully customisable inner foam!

Tools shown not included

Missile Switch Cover



Great for automotive switch panels etc. Suits heavy duty toggles. Cover only, switch not included. **STICK SOME IN THE CAR FOR THAT STREET RACER LOOK!**

$9.95
S 1058

NEW

Multi function tester!

$9.95
Q 3000

PICK ONE UP FOR THE TOOLBOX!

Feature packed, this screwdriver style tester performs a multitude of electrical test functions! It's able to check continuity, DC volts presence, microwave oven leakage and locate 240V AC mains wiring. With inbuilt LED and buzzer to indicate test status.

NEW

SUPER BRIGHT LED torch

WATERPROOF TO 30m!

NEVER CHANGE A GLOBE AGAIN!

Powered by 7 high power Japanese made LEDs (rated at 100,000hrs), it can operate for up to 30hrs with just one set of batteries! Fantastic for divers, hikers, campers or for the glovebox in case of roadside emergencies! Includes 4 x AA batteries!

$39.95
RRP $49.95
X 0200

NEW

TIN-O-CDRs!

Metallic coated to ensure accurate copying and less long term data "fade". 700mb/80min. 60 pack in a convenient tin.

$39.95
D 0247

SAVE $20!

SUPER BONUS PACK! 60 FOR THE PRICE OF 50!

Luxeon® Star Power Supply Kit

(SC Jan '04) This miniature high efficiency switchmode power supply is designed to power a 1W Luxeon Star LED from just two D cell batteries (or up to 20 hours). It even has brightness control! Great for a low voltage lighting system in a caravan or boat!

$42.50
K 1000

NEW

Luxeon® Stars

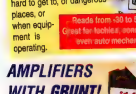
High power LEDs fantastic for use in low voltage lighting. They put out an incredible amount of light! Full specs available from: **www.luxeon.com**
Z 0690: White LXHL-MW1 C
Z 0691: Warm White LXHL-MWG C

$16.95

NEW

EXTREMELY POPULAR! GET IN FAST OR MISS OUT!

Laser DIGITAL Thermo-GUN!



Lightweight and easy to use, this "non contact" infra red thermometer provides accurate temp measurement of any object. Great for taking readings in hard to get to, or dangerous places, or when equipment is operating.

$159
Q 1290

Reads from -30 to 550°C
Great for techie's, consultants, even auto mechanics!

NEW

Why buy a quad processor?

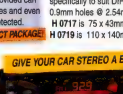
$249
S 9479

NEW

WHEN THIS COMPACT USB DEVICE CAN DO THE SAME JOB! It accepts up to 4 camera inputs and displays them on your PC monitor. The powerful software provided can set up recording schedules and even record when motion is detected.

POWERFUL YET COMPACT PACKAGE!

Make your own prototypes



Printed and drilled specifically to suit DIP packaged IC's. 0.9mm holes @ 2.54mm spacing.
H 0717 is 75 x 49mm.
H 0719 is 110 x 140mm

5 for $6
RRP $1.95ea
H 0717

5 for $15
RRP $4.60ea
H 0719

Test batteries in a flash!

BARGAIN! This pocket tester is the *FASTEST* way to check battery life, ANYWHERE! ANYTIME! Tests: D,C,AA,AAA,9V & button cells.

$4.95
Q 3200

Why waste $$$ on batteries you throw away?

These high spec, high output nickel metal hydride rechargeable batteries are good for up to 1000 recharges! ie: They will last you for DONKEYS YEARS!

HUGE 2.1Ah CAPACITY!

Great for digital cameras, discmans etc.

NiCad & NiMh Battery Charger

GET INTO THE *HUGE* SAVINGS THAT RECHARGEABLE BATTERIES PROVIDE!

This charger keeps batteries in top nick and ready to go. Includes an auto discharge function that prevents shortening of battery life in NiCads. **Features:** • Charges up to 4 batteries at a time • Suits for AAA, AA, C, D, 9V batteries. *^No discharge function for 9V batteries.*

$39.95
A 0288

NEW

SPECIAL DEAL! Get $10 off the price of the A 0288 when you buy 2 packs of NiMH batteries!

AMPLIFIERS WITH GRUNT!

Give your car audio some REAL power with these serious high power amplifiers! All models feature very low distortion and superb frequency response from their modern mosfet design. In-built low pass filters allow easy connection to your subwoofer. **Check out our website for full details.**

$149
C 9241
RRP $279
2/1ch 300W

$225
C 9251
RRP $375
4/3/2ch 600W

$499
C 9247
2/1ch 900W

NEW

4x45W CD Tuner

GIVE YOUR CAR STEREO A BOOST!

Control your car sound system with ease! Featuring in-built DSP (pop, rock, classic modes) and 4 x 45W amp, front and rear RCA line level preouts, detachable face panel, spectrum analyser display, 30 station memory tuner, bass, treble and fader controls.

$219
C 9198

Features a stylish flip down face. Multicoloured display. LOOKS AND SOUNDS FANTASTIC!

21 Range LCR Meter

This super accurate 21 range LCR meter is perfect for developing circuits with audio crossovers, switchmode power supplies, resonant filters & RF components. This new LCR meter allows quick and easy measurements of inductance, capacitance and resistance.
• Diode test function • Jumbo LCD display for easy reading
• Test leads, carry case and rubber holster included.

$99
Q 1154

NEW

■ EXPRESS
Overnight Delivery!*

■ NO RISK
14 day money back guarantee†

ALTRONICS

MP3 PLAYER KIT!

Hard disk not included.

Store all of your music in one compact unit!

$329	$149
K 2770	K 5105
MP3 Player	15W Amp

Complete MP3 system. Add an 80gb hard disk and you could have up to **8 WEEKS** of continuous music! 12V operation and compact size means it can fit almost anywhere. Accompanied with the **K 5105** (pictured) 12V 15W stereo amplifier and you have a perfect bookshelf sound system.

350W Studio Amp Module Kit

NEW

(SC Jan-Feb '04)
Delivers 200W RMS into 8Ω, 350W RMS into 4Ω with very low distortion. The perfect amplifier for DJ's or home studios. Supplied with diecast heatsink.

$199.95
K 5185

PC Supply Rail Monitor Kit

NEW

(SC March '04)
Provides visual indication of the condition of your PC's power supply rails (3.3V, 5V and 12V). This information is vital in ensuring your PC hardware isn't damaged by your power supply failing or producing too much voltage.

$29.95
K 2895

Radio Modem Kit

(SC November '03)
This simple radio modem enables your PICAXE, STAMP and other micros to communicate without wires. Perfect for remote control and sensing circuits (eg: remotely turn on fans when temperature of equipment is high). Includes RS232 option. Max wireless data rate, 465bps.

$54.95
K 9000

SLA BATTERIES!

Great for security systems, UPS, telecommunications gear etc. Now up to a WHOPPING 40Ah!

*Cannot be sent by air

NEW HIGH CAPACITY SERIES

	3Ah	7.2Ah	12Ah	20Ah	26Ah	40Ah
	$ 5080	$ 5096	$ 5098	$ 5100	$ 5104	$ 5113
Each	$24.95	$36.95	$42	$48	$65	$105
2+	$20	$25	$38	$46	$59	$100

Frequency Counter

SAVE $50!

This multiple-function counter covers a frequency range of 10Hz to 1GHz in two ranges with separate BNC inputs; Ch A 10Hz to 100MHz and Ch B 100MHz to 1GHz. The wide frequency range makes it suitable for servicing and calibrating RF equipment such as radio mics, CB and amateur transceivers. **Features:** • 8 digit LED display • High input sensitivity • Period, frequency and pulse count (totalise) functions • x20 input attenuator • Handy inbuilt bench stand

$379
RRP $429
Q 1535

FREE REMOTE CONTROL

Purchase the K 2770 for $329 and pick up the A 1013 remote control FOR FREE!

Waterproof Remote

Perfect by the pool or in the kitchen! Replaces up to 4 of your current AV remotes. Suits most brands.

$27.50
RRP $32
A 1013

Wireless communication!

NEW

This Bluetooth USB dongle allows quick and easy communication with other bluetooth devices such as access points, PDAs, phones and other computers. 10m range.

$49.95
D 0380

Function Generator

INCREDIBLY VERSATILE - 3 IN ONE...

As well as providing a consistent waveform this unit is able to automatically sweep through a range of frequencies making it very useful for checking response of audio circuits etc. It has variable sweep rate and width, as well as functioning as a standard waveform generator with sinusoidal, triangle and square wave outputs. DC offset and symmetry. Output frequency is adjustable via front panel rotary dial over seven ranges. It also features a 2 MHz 4 digit frequency counter.

$499
RRP $549
Q 1560

...FREQUENCY COUNTER, SWEEP GENERATOR & FUNCTION GENERATOR.

Indoor - Outdoor thermometer

Keep an eye on the temperature no matter where you might be! The wireless thermometer can let you know what's happening outside at a glance. **Features:**
• Weatherproof remote sensor • 30m range • Temp range 0°-50°C
Great for remote monitoring greenhouses, cellars etc.

$45
A 0147

Handy Centrepunch!

NEW

One of the most handy tools you'll ever buy! Its the easiest way to mark out cuts & holes in project panels ensuring a neat professional finish.

$9.95
T 2240

Adjustable tension makes it perfect for wood,metal or plastic

Turn any DMM into a clamp meter!

$22
RRP $29.95
Q 0960

Don't pay $200-300 on a clamp meter when you can buy this for just $25! Measures up to 300A AC. Simply plugs into the AC volts range.

BONUS
Q 1055 Case Valued at $7.30

The Amazing Underwater Cam!

B&W with infra red illumination. Great for outdoor use, or even as an aquarium cam! Waterproof to 30m.

$165
RRP $185
S 9080

Set up your own aquarium camera! Brilliant performer, even outdoors or wetter prone areas.

Ultra Mini Blowtorch

$19.95
T 2488

Produces a powerful jet like flame! Brilliant for camping, hiking or even as a cigar lighter! • adjustable flame • refillable gas chamber • one click piezo ignition • sturdy metal construction Fits right onto your keyring! **12 month warranty.**

***FREE** CAN OF GAS WITH EVERY T 2488 SOLD! Valued at $4.95*

60W Pro Soldering Station

Top of the line with all the bells and whistles! Featuring tip temperature display and quality Japanese ceramic heating element for rapid heat recovery. **Features:** • Dual mode LED temp display • Zero-volt switching • Light weight ergonomic mini handle • Temp range 200 - 500°C • Temp lock facility **NEW LOW PRICE! SAVE $211**

$229
T 2438

FREE $40 BONUS PACK* Purchase the T 2438 & receive a free T 2439 solder holder and a 1kg roll of T 1115 solder (as shown) valued @ $40.55.

Cheap insurance for your expensive appliances

Protect your equipment from from damaging surges and spikes.

Great for protecting ADSL modems!

	1 Way+Phone	6 Way	6 Way+Phone
	P 8131	P 8131	P 8151
Each	$15	$20	$25
Normally	$19.50	$27.50	$30

Regulated Bench Power Supply

Delivering 3V, 4.5V, 6V, 7.5V, 9V and 12V at up to 1.5A continuous capacity. Great for voltage sensitive devices like portable TV sets, video games, radios, scanners. Features short circuit and overload protection.

SAVE OVER 25%!

$29.95
RRP $39.50
M 8238

Phone 1-300 797 007
Fax 1-300 789 777

MAIL ORDERS C/- P.O. Box 8350 Perth Business Centre, W.A. 6849
Perth Retail Store: 174 Roe St. Perth W.A. 6000
NSW & ACT MAIL ORDERS C/- P.O. Box 6732 Silverwater, N.S.W 2128
Sydney Retail Store: 15 Short St. Auburn N.S.W. 2144

Authorised Resellers:

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Vintage Radio

By RODNEY CHAMPNESS, VK3UG

Cataloging & disposing of your vintage radio collection

Keeping records and other information is an important part of vintage radio collecting. It's also important to sort and store spare parts in an orderly manner, otherwise you'll never be able to find anything when you want it!

From time to time, individual collectors and groups (such as the Historical Radio Society of Australia and the New Zealand Vintage Radio Society) organise special functions for displaying vintage radio collections and other artefacts associated with vintage radio. This equipment now forms a valuable part of our radio history, the more so when additional information from the era is included.

Literature and signs and any other artefacts pertaining to the hobby all help to enhance any collection in an historical sense.

Why keep records?

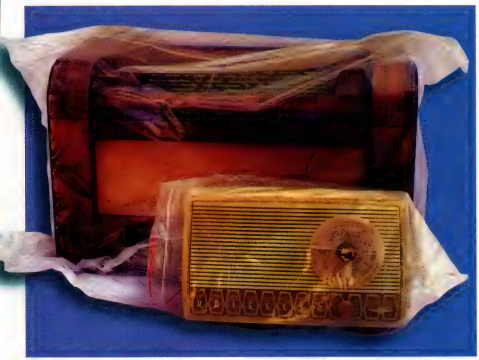
Keeping records and other information about our vintage collections is an important part of the hobby. However, some collectors find that their interests change after a number of years and may therefore wish to dispose of their collection. Another likely scenario is that the collector may wish to move to a retirement village and may no longer have the necessary space to store vintage radios.

Obviously, all the hard work involved in putting a vintage radio collection together will come to nothing if it is just carted to the local rubbish tip when you can no longer accommodate it. And that would be a great shame.

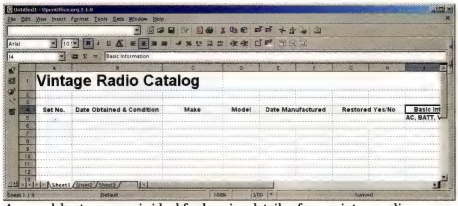
An article in the NZVRS Bulletin for February 2002 by George Newlands titled "Some Ideas and Advice On The Disposal of a Collection" got me thinking about what will happen to my collection when I eventually move to a retirement village (or die). What would my kids do when I can no longer take an interest in my collection? They certainly don't share my interest in vintage radio and I would hate to think that my collection would be taken to the tip because it is "just so much old junk"!

Recently, I saw the collection amassed by a (now deceased) hobbyist in South Australia and was asked to give an indication as to its value. Unfortunately, his wife had no idea where to turn for assistance in disposing of the collection. Her husband had died some time back and in the meantime, some so-called "helpers" had helped themselves to quite a few pieces of equipment, which left a nasty taste in the lady's mouth.

Going from what is left, there must have been some quite valuable pieces in the collection which are now gone.



Plastic bags can be used to protect vintage radio sets when they are not in use or on display. Be sure to store them in a cool dry place, away from direct sunlight.



A spreadsheet program is ideal for keeping details of your vintage radio collection. Don't have Excel? – try the spreadsheet that's included in OpenOffice (it's free).

And in some cases, the prices paid were so low as to be considered an insult. She has been offered $3000 for what's left, which fills a shed around 15 metres square. However, just five items that I recognise are worth almost $3000 – never mind the rest of the gear!

That said, there are a couple of good reasons why the collection is worth much less than it should be. First, the collector had dismantled many sets in the course of his restoration work and they are still in bits. Second, he had no record of the items in his collection. With sets in bits, it would take weeks to find out which pieces belonged together. Even then, with such a large collection, it may not be possible to be sure what belonged with what.

Identifying makes and models is not easy when they are in pieces and spread around the storage area. Unfortunately, the restorer had been struck down with a stroke in the middle of his work, hence the chaos.

What do we do?

Most of us who start out in this hobby are initially so enthusiastic that we rarely organise our collections properly. Instead, when we come across all those "beaut" vintage radios out there, we tend to grab them and hoard them but we generally have no idea which way our hobby is going. The result is a garage or room full of equipment that we've collected and stored in all sorts of odd places.

To make matters worse, if you are like me, you tend to forget what you have and where you have put it. Keeping accurate records of what we have, where the items are and the spares that we have for restoration is usually not done – mainly because we think of it as a chore to be avoided.

However, keeping accurate records doesn't have to be a chore, as even quite simple systems can be quite effective. For example, one of the members of our local vintage radio club does keep very good records and these are a good example of just how useful they can be to the hobby. Every set in his collection is given a number and a label is attached to each set with that number. The number is then recorded in a book and on a file folder.

The file folder includes all the information he has on the set and the work done to bring the set up to standard. He also knows where each set is located in his collection. Can I do this? Well, not really, although I do know where the important (to me) sets are located. I also know if they have been restored and I keep circuits and other information in various folders. However, I am like most other collectors, where record-keeping takes a back-seat compared to other activities of the hobby.

An old chest of drawers makes a handy storage cabinet for vintage radio parts. Self-adhesive labels make the parts easy to find.

On the other hand, the article by George Newlands and my recent experience of seeing a potentially wonderful collection in disarray has really got me thinking. Most collectors, including me, really need to look at cataloging their collections. We also need to better protect restored receivers and become more methodical in our methods of storing and accessing spare parts.

This column has covered the restoration of many fine radios from the early 1900s to the 1970s. But once we've restored them, what do we do with them? Do we store them in the damp and dusty garage with junk in boxes put on top of them or do they have pride of place in the lounge room as they did many years ago? It really is a shame if we leave the elements to once again wreak havoc on a set that required so much effort to restore to working order.

Cataloging your equipment

Keeping a record of the equipment you have can be done in a couple of ways and need not be arduous. I simply use a large exercise book, suitably ruled up to keep track of my equipment and what has been done to it. Alternatively, computer-literate restorers could use a spreadsheet program to record equipment information and, in fact, I've recently started transferring some of my own records to a computer-based system.

What sort of data should be in such a catalog? The information can be as simple or as complex as will satisfy your own needs. Here are a few column headings that you could use.

(1). Set Number: this is needed so that individual sets can be easily identified. This number can be attached to the set with a removable label in an inconspicuous location.

(2). Date Acquired: this is often handy to know.

(3). Make: this helps identify and catalog brand names.

(4). Model Number: so that you can quickly check what you already have.

(5). Year of Manufacture: so that you

Multi-drawer parts cabinets (available from electronics retailers) are ideal for storing smaller components.

can quickly check a set's age.
(6). Restored – Yes/No: let's you check whether or not the set has been restored to working order.
(7). Date Restored: so that you know how long ago the set was restored. If the set hasn't been given a run for some time, it should be "fired up" to make sure nothing has deteriorated since restoration.
(8) Condition When Acquired: this is purely so that you can look back and remember how much work was put into the restoration task.
(9). Brief Details On The Set: this information can include whether it is dual-wave, 4-valve or 5-valve, battery or AC operated, etc.
(10). Cabinet: wooden, Bakelite, plastic or other.
(11). Cabinet Type: console, table, mantel, portable, other.
(12). Work Done on Set: briefly indicates the work that was necessary to restore the set to working order.
(13). Where Located: in the garage, in the lounge room, etc, or loaned out to someone.
(14). Approximate Unit Value: this can be filled in when the prices of sets at auction and elsewhere become known.
(15). General: a column to record other bits and pieces of information about the set. Reference can also be made to suitable spares that may be stored in your workshop (wrecked chassis are a good source of parts).

Of course, you may need more or less columns than this but that's up to you.

Cataloging other items

Having cataloged your complete equipment, it is also desirable to have a catalog of wrecked chassis, new and used components, and any literature and circuits that you have. Although I don't have a catalog as such for my new components, I do have them sorted in a logical manner.

For example, capacitors are sorted into values and voltages, and the physically smaller ones stored in small, resealable plastic bags (available from supermarkets, etc). A black marker pen is used to record the capacitor

A ring-back binder is used to keep the author's vintage radio catalog neat and tidy. It lists all the sets in the my collection and their location, along with other relevant details.

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ALL MAJOR CREDIT CARDS ACCEPTED

Photo Gallery: 1934 Eclipse Radio "Endeavour Midget"

Manufactured by Eclipse Radio, Melbourne, in 1934, the Endeavour Midget was housed in a small, ornate wooden cabinet. It employed a 5-valve superhet circuit and tuned the medium-wave band. Its valve line-up was as follows: 77 (autodyne mixer), 6D6 (IF amplifier), 77 (anode bend detector), 89 (audio output stage) and a 280 (rectifier). Photo: Historical Radio Society of Australia, Inc.

values on the outside of each bag and the bags are all then placed in order in a suitably marked box.

It may sound like a lot of bother but it isn't really – not when compared to searching for a particular value among hundreds (or thousands) of other parts.

Similarly, my resistors are all sorted into values and wattage ratings and are housed in a number of multi-drawer parts cabinets. These cabinets are readily available from electronics stores, some of which advertise in SILICON CHIP.

I also keep a list of all the valves I have and whenever I acquire or use some, I note this down on my valve list. As a result, I can quickly check which valves types are in my collection and I also know how many of each particular type I have.

Once again, all the valves of a particular type are placed in a plastic resealable bag which is marked on the outside with a marker pen. A lot of my valves are "pre-loved" and so I can't identify them by their boxes – because they don't have any.

Those items that aren't really suitable for cataloging can be stored in boxes that are suitably labelled with the contents. If you can obtain a number of boxes of the same size, it can make storage much easier as they can be easily stacked. In fact, I have been able to obtain a number of boxes that contained six reams of A4 paper, so I have a relatively uniform storage system. I also have some of my shelves labelled to indicate what items are stored on them.

If possible, try to keep your vintage radio parts in one area, as it makes finding things just that bit easier. And be methodical with your records as you will not be able to remember where everything is located.

Books & circuit diagrams

I've always been a bit of a magpie and so I have accumulated many radio/electronics books, magazines, circuits and other literature over the years. This collection has proven to be very useful, as restoration is much easier if you have the relevant information (particularly circuits). Additionally, these sources are invaluable for cross-checking the accuracy of the information in my vintage radio articles.

The storage of books and other printed matter is an art in itself and large libraries go to quite a bit of trouble to preserve their collections. Many will have noticed that some editions of their Australian Official Radio Service Manuals have paper that has discoloured and is very easy to tear. I understand that this is due to the type of paper used, which had quite a high acid content.

I'm no expert on how to look after printed material but I usually store valuable books in re-sealable plastic bags. If you're really keen, any really useful information can be scanned into a computer and stored on a disc to give fast access.

Protecting vintage radios

The first thing to be aware of here is that ultraviolet radiation from the Sun can be quite harmful to the cabinet and general finish of vintage radios. After all, when the sets were made, it was not anticipated that they would still be around 50-80 years later. Keeping vintage radios out of direct sunlight and in a dry room will greatly increase the longevity of the cabinet finish and the internal works.

An example of the damage ultraviolet rays can do can be seen in the way that the red paint on many signs fades over time. Remember too how the clear 300-ohm ribbon feeder used on TV antenna systems many years ago would disintegrate within about a year when exposed to the Sun. So keep your vintage radios out of the Sun.

Dust and household airborne chemicals can be harmful too. I remember years ago having to service a TV set in a household of heavy smokers. The whole of the set was covered in a brown sticky goo, including the chassis components, the cabinet and the screen. In that set, simply cleaning the screen made quite a difference to the brightness of the picture! In addition, the tuner contacts needed cleaning, along with many other things.

Of course, I'm not suggesting that your vintage sets will suffer like this TV did. However, they will suffer to some extent if there are smokers in the

These cardboard boxes once held reams of paper but are now used to store the author's valve collection. Each box is clearly labelled to show contents.

house (as will the smokers).

One thing is certain: the lounge room will be a cleaner environment than the kitchen, with its cooking fumes. If a receiver is going to be used in the kitchen, a build up of muck can be expected over a period of time and this will need to be cleaned off occasionally.

If the radio is only used rarely in the home, it can be protected using plastic sheeting or, in the case of console sets, using a blanket. Ideally, though, sets should be stored in glass display cases to exclude dust but this is hardly practical in 99% of cases.

Disposing of your collection

Several members of our local club have disposed of either part or all of their collections in recent years. In fact, one member decided to auction his entire collection after losing interest in the hobby. Before doing so, he advertised his collection widely and, when auction day rolled around, there were buyers from interstate.

Another decided to auction his collection as he was terminally ill and didn't want to leave the task of disposing of his collection to his wife. He hadn't kept a listing of his collection and several people were involved in cataloging it as best they could. This wasn't complete by auction day but it was still a successful auction, despite a few items being left unsold.

A third member decided to rationalise his collection and he arranged for it to be auctioned at a local hall. Fortunately, he kept very meticulous records which made it relatively easy to compile an accurate catalog. His collection was also extensively advertised and again there were buyers from interstate at the auction.

Another way of disposing of individual items is to see if any of your relatives or friends would like to have them. Local museums may also be interested in individual items from your collection, so keep them in mind.

In summary, well kept records will make your collection much more enjoyable, both for you and anyone visiting who may be interested in vintage radio. Additionally, it is wise to have your collection cataloged for insurance purposes. You may even need proper valuations to fully insure any really valuable items.

Finally, regardless of the circumstances, when it comes to disposing of your vintage radios, try to make sure that they are passed on to those who appreciate their historical value. **SC**

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FLUID LENSES:
bringing things into focus

At this year's CeBIT Exhibition in Hannover, Germany, Philips Research demonstrated FluidFocus: a unique variable-focus optical lens system that has no mechanical moving parts.

Suited to a wide range of optical imaging applications including such things as digital cameras, camera phones, endoscopes, home security systems and optical storage drives, the FluidFocus system mimics the action of the human eye using a fluid lens that alters its focal length by changing its shape.

The new lens, which lends itself to high-volume manufacturing, overcomes the fixed-focus disadvantages of many of today's low-cost imaging systems.

The FluidFocus lens consists of two immiscible (non-mixing) fluids of different refractive index (optical properties). One is an electrically conducting aqueous solution and the other an electrically non-conducting oil, both contained in a short tube with transparent end caps.

The internal surfaces of the tube wall and one of its end caps are coated with a hydrophobic (water-repellent) coating that causes the aqueous solution to form itself into a hemispherical mass at the opposite end of the tube, where it acts as a spherically curved lens.

The shape of the lens is adjusted by applying an electric field across the hydrophobic coating such that it becomes less hydrophobic – a process called 'electro-wetting' that results from an electrically induced change in surface-tension.

As a result of this change in surface tension, the aqueous solution begins to wet the sidewalls of the tube, altering the radius of curvature of the meniscus between the two fluids and hence the focal length of the lens.

By increasing the applied electric field, the surface of the initially convex lens can be made completely flat (no lens effect) or even concave.

As a result it is possible to make lenses that transition smoothly from being convergent to divergent and back again.

In the FluidFocus technology demonstrator exhibited at CeBIT 2004, the fluid lens measured 3mm in diameter by 2.2mm in length, making it easy to incorporate into miniature optical pathways.

The focal range provided by the demonstrator extends from 5cm to infinity and it is extremely fast: switching over the full focal range is obtained in less than 10ms.

Controlled by a DC voltage and presenting a capacitive load, the lens con-

Shapes of a 6-mm diameter lens taken at different applied voltages. *Photo: Philips*

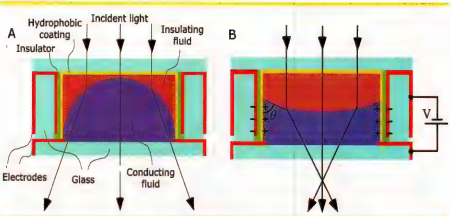
At left: researchers show the miniature variable lens along with the camera that contains the lens. ***Photo: Philips***

sumes virtually zero power, which for battery powered portable applications gives it a real advantage.

The durability of the lens is also very high, Philips having already tested the lens with over one million focusing operations without loss of optical performance.

It also has the potential to be both shock resistant and capable of operating over a wide temperature range, suiting it to mobile applications.

Big Brother may soon be watching you . . . in focus! **SC**



A) Schematic cross section of the FluidFocus lens principle. (B) When a voltage is applied, charges accumulate in the glass wall electrode and opposite charges collect near the solid/liquid interface in the conducting liquid. The resulting electrostatic force lowers the solid/liquid interfacial tension and with that the contact angle and hence the focal distance of the lens. *Diagrams: Philips.*

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Poor Man's Metal Locator

By Thomas Scarborough

This unique metal locator contains just five components – a low-cost IC, a variable capacitor, two search coils and a crystal earpiece. And believe it or not, despite the apparently simplicity it is capable of surprisingly good results.

This circuit represents a brand new genre of metal locator. Although it borrows from other kinds of locators/detectors, its basic principle of operation is new.

And while this may seem to stretch one's credulity, the performance matches that of a budget Induction Balance (IB) detector.

Build it – and you will see!

During testing, it detected an old English penny at 150mm (6") in air. However, I would only put my neck on the block for 125mm (5"), since a number of factors influence sensitivity. It roughly matches the performance of the now sadly misnamed Matchless Metal Locator (SILICON CHIP, June 2002), while using just one-fifth of the components.

This locator may therefore represent the writing on the wall for budget IB types and even puts paid to most of the advantages (the few remaining ones) of Beat Frequency Operation (BFO) detectors.

Overview

Instead of using a search and a reference oscillator (as in the BFO type), or transmit and receive coils (as in IB), this detector uses two transmitters (or search oscillators) with IB-style coil overlap.

As will be seen from Fig.1 and our photographs, these are extremely simple in design. Each oscillator comprises just one-quarter of a common quad opamp IC plus the search coil!

The frequencies of the two oscillators are then mixed (in similar fashion to BFO) to produce an audible heterodyne.

On the surface of it, this design would seem to represent little more than a twinned BFO metal locator. However, what makes it different above all else (and significantly increases its range) is that each coil modifies the frequency of the adjacent oscillator through inductive coupling. This introduces the "balance" that is present in an IB metal locator, and boosts sensitivity well beyond that of a BFO.

Beyond this, all that is required is a means to control the mixer output frequency, so that the metal locator may be tuned. This could be accomplished in a number of ways but the method chosen here is a variable capacitor (a standard 100pF AM radio tuner) wired between the two oscillator outputs.

Since the concept borrows from both BFO and IB, we shall give a nod to each of these by naming the principle "Beat Balance".

Characteristics

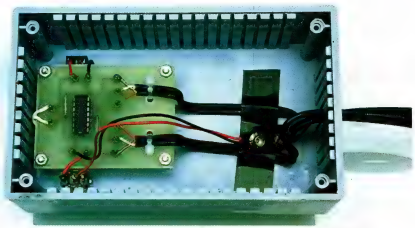
The main characteristics of beat balance (BB) are as follows:

- Depending on the way it is designed, a BB metal locator potentially offers the same sensitivity as IB.
- It requires no receiver amplifier or level detector, thus vastly simplifying design and reducing cost. The present circuit uses just two main components, while matching the performance of a budget IB metal locator (which would probably have 10-20).
- Both search oscillators are identical, therefore BB offers high immunity to voltage and temperature variations. This obviates the need for compensation circuits, including voltage regulation.
- Each search coil has the opposite response to metal, thus BB has a high degree of immunity to ground mineralisation. At the same time, it offers good discrimination at the point where the two search coils overlap

The circuit

The design is based on the simplest of inverter oscillators. As far as I am aware, this two-component op-amp oscillator also represents a first.

Let us focus first on IC1a. Since an inductor resists rapid changes in voltage (called reactance), any change in the logic level at IC1a's output (pin 1) is delayed during transfer to inverting input pin 2. An approx. 8V/µs slew rate further delays switching of IC1a, thus setting up a rapid oscillation.



No, it's not part of the circuit. This view inside the box shows the WHOLE circuit (with the exception of the coils, of course, and the tuning capacitor hidden under the PC board.)

One end of the search coil is further wired to the non-inverting input (pin 3), which stabilises operation. While pin 3 could be left "floating", this would be a less satisfactory arrangement.

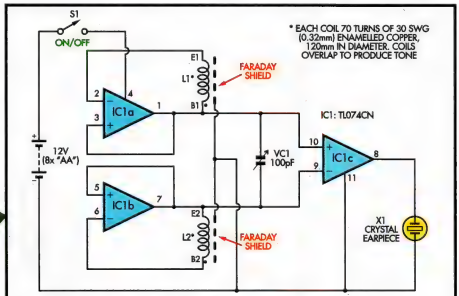
Since different ICs have different slew rates, as well as different input impedances, they are unlikely to work in this circuit. However, the TL074CN IC is widely available and there should be no sourcing problems.

The search coil is a critical part of the oscillator and needs to be suitably designed to achieve oscillation and to obtain the required frequency.

While this frequency needs to be high, it should not be so high that noise or instability are introduced. Both the characteristics of IC1 and the inductance of the coil influence oscillator frequency, which lies around 260kHz without a Faraday shield. The Faraday shield approximately doubles the inductance of the coil, thus roughly halving the frequency.

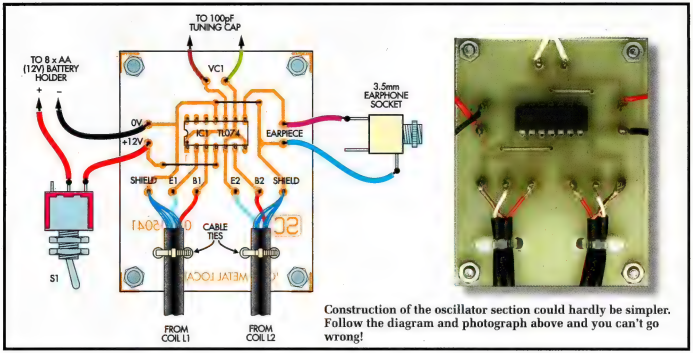
IC1b is, wired in exactly the same way as IC1a, except that its search coil is connected in opposite phase.

As the search head is swept over the ground, the presence of metal increases the inductance of L1 and then L2, or vice versa, thus bringing about



SC POOR MAN'S METAL LOCATOR

. . . and here's the proof. It could hardly be any simpler, could it?



Construction of the oscillator section could hardly be simpler. Follow the diagram and photograph above and you can't go wrong!

a dip in the oscillator frequencies. A third opamp, IC1c, is used to mix the output of the oscillators, thus creating an audible difference frequency, or beat frequency.

This leads us to the one distinctive feature of BB. Not only does the presence of metal alter the frequency of a search oscillator but as in the case of IB, it also influences the adjacent coil. In fact, both coils influence each other through mutual induction, thus greatly enhancing the sensitivity of the system.

Beyond this, we only need to find a method of tuning the metal locator. This is achieved through variable capacitor VC1, which further couples the two inductors (the search coils), thus offering a means of controlling balance. Almost any variable capacitor should work in this position, although it should preferably have a smaller value; eg, 47pF to 100pF. A small value capacitor (eg 47pF) may be wired in series with VC1 to reduce a larger value.

A crystal earpiece is used for sound output. While a piezo sounder may be used (without integral electronics) this is not likely to offer good volume. If the volume in the earpiece is too high, use a suitable series resistor to reduce it. An inductive sounder or earpiece is not recommended, because it could overload IC1c.

Current consumption is around 15mA. Therefore an AA battery pack (8 x AA batteries) should last around 70 hours.

Construction

There is so little on the PC board that it would be difficult to make a mistake. OK, so you could put the IC in back-to-front, likewise the search coils' starts and ends could be inadvertently swapped. Apart from that, though, there's precious little to worry about.

Fit the 12 stakes to the PC board and solder them into place, then solder the two jumper wires as shown. Normally we would say use resistor lead offcuts for this – but there aren't any! You'll have to use some tinned copper wire instead.

Now comes the challenge of populating the PC board! Since this is a sensitive, high-frequency circuit, I would recommend that IC1 be soldered directly to the PC board (ie, not socketed). So long as you insert this component the right way round, there would appear to be little to go wrong! The TL074CN is a fairly "tough bird"– but be reasonably quick with the soldering iron.

Wire up the variable capacitor VC1, the socket for the crystal earpiece and the battery and switch (carefully note the polarity of the battery leads – an error here could destroy the circuit). It's usual to insert the on-off switch in the positive battery lead. Some battery holders have solder tags, others (such as the one we used) need a 9V battery snap to connect them. Again, watch the polarity!

Now mount the on-off switch and the jack socket (for the crystal earpiece) on the case. I used long bolts to clamp VC1 underneath the PC board and found this an easy and effective way

Two overlapping coils are wound using 30SWG wire and fastened to a non-metallic base. Fig.8 microphone cable connects the coils to the oscillator.

of fixing the variable capacitor to the case. I used a slice of non-conductive rubber to isolate VC1 from the back of the PC board.

Next, wind the two search coils. They are 70 turns of 30SWG (0.315mm) enamelled copper wire on 120mm diameter formers. Faraday electrostatic shields are essential for circuit stability. These are connected to 0V and should use balanced (figure-8) screened microphone cable. Winding of the coils is not critical, and a little give and take is permissible. However they should be as close as possible to identical.

Wind the coils around the formers, temporarily holding them together by passing stubs of insulating tape under them and pressing them together over the top. Once you have wound the coils, bind them tightly with insulating tape around their entire circumference. Scrape the enamel off the ends of the coils' enamelled copper wires to solder them to the microphone cables.

Now add Faraday shields. Prepare some long, thin strips of aluminium or tin-foil. Twist a 100mm length of bare wire around each coil, over the insulating tape. This wire provides electrical contact with the foil and is soldered to the microphone cables screens.

Beginning at the base of the bare wires, wind the foil around the circumference of the coils, so that no insulating tape is still visible under the foil – but the foil should not complete a full 360 degrees.

Leave a small gap (say 10mm) so that the foil does not meet after having done most of the round. Now again tightly bind the coils with insulating tape around their entire circumference.

Attach the coils to the circuit by means of the specified microphone cables, being careful to identify the beginning and end wires correctly as shown. If these are not correctly identified, there could be a 20% loss of sensitivity. The Faraday shields should be connected to the cables' screen and to 0V on the PC board as shown.

Parts List – Poor Man's Metal Locator

- 1 PC board, code 04105041, 51 x 64mm
- 1 plastic case, 150 x 90 x 50mm
- 1 TL074CN quad op amp (IC1)
- 1 10-100pF variable (tuning) capacitor, with knob
- 1 crystal earpiece
- 1 3.5mm mono earphone socket
- 1 8x "AA" battery holder and batteries
- 1 battery snap (if required by holder)
- 1 SPST power switch
- 55m (approx.) 30SWG enamelled copper wire
- 2 lengths twin shielded balanced microphone coax (fig.8), approx. 2m long hookup wire
- 2 20mm lengths tinned copper wire (for PC board links)
- 2 lengths of aluminium foil, approx. 20mm wide (for shield)
- 1 length PVC conduit to suit (handle)
- 4 20mm M3 screws and nuts
- Suitable cable ties
- Clear polyester resin

Hardware

The "hardware" construction is just as simple as the rest of the design. The two search coils are fixed to a plate of Masonite or similar, with a single PVC electrical conduit shaft attached. The control box, containing all of the electronics apart from the coils, attaches to the shaft via a pair of cable ties.

The top of the shaft is then held in the hand just above the control box, while its upper length rests against the back of one's forearm.

Use a stiff, non-metallic plate for the search head. Masonite is both stiff and easy to work with (I cut up an old Masonite clipboard for the purpose). Before the coils (or anything else) are attached to the base plate, their best operating position needs to be determined.

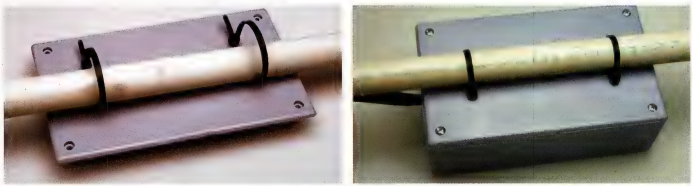
Begin by placing the two coils on the search head plate, directly on top of one another (that is, "meshed"), with their beginning and end wires positioned as shown. Turn VC1 to its mid-position. Switch the detector on, then slowly move the coils apart.

When the coils have all but been separated from one another, a tone will be heard in the crystal earpiece. Adjust the coils' positions so that this is a fairly low tone – then drill holes and use cable ties (several for each coil) to fasten them in this position on the plate.

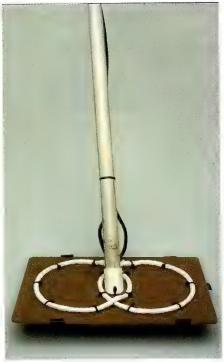
Once the cable ties have been tightened, carefully bend the coils until a low tone is again heard in the crystal earpiece. To lower the tone, create a greater overlap of the two coils (ie, a larger segment in the middle), and vice versa.

To construct a shaft, saw the end off a length of PVC piping at a 25° angle. Drill holes through the pipe close to its bottom end and holes through the centre of the search plate. Then bind the pipe to the search plate with cable ties. The pipe (or shaft) will later be fixed permanently to the search plate with clear polyester resin (see below).

The two coils need to be set rigidly in position on the search head, so that they will not move even slightly when



The lid is secured to the PVC pipe by means of a couple of cable ties. When these are pulled tight, they really grip well! Then the lid (which is effectively now the base) is screwed onto the box – and presto!



The "works" box (left) mounted near the top of the PVC tube shows the front of the box with the earpiece socket, tuning capacitor and on/off switch. We haven't put a fancy label on this project – it would sort of ruin the effect, wouldn't it? Besides, the label would be on the underside. At right is the coil end, showing how it mounts to the PVC tube.

the metal locator is in use. I would recommend that they be potted in clear epoxy resin, which is available from most hardware stores, together with the necessary hardener or catalyst.

A section of one coil should be left exposed where the two coils intersect, so as to enable final fine adjustment. This section of coil may be temporarily protected with Blu-Tac.

Be sure to plug the holes beneath the search head before pouring the resin, since it is very runny and sticks faster than many glues! The detector's PVC shaft is bound to the search head with the resin.

I tied the control box to the shaft with cable ties and used a little all-purpose glue to assist. Cable ties were further used to bind the cables to the shaft. No hand grip was attached to the prototype but the shaft was kept long at the top, so as to rest against the back of my forearm as I gripped the shaft with my hand.

Checking it out

Once construction is complete and everything checked, switch on and tune VC1 until a clear difference frequency or heterodyne is heard in the crystal earpiece. This should ideally be a low tone of just a few tens of Hertz. It will be found that sensitivity is dependent to some extent on tone and some experimentation will yield the best frequency. If necessary, further adjust the coils, moving them further apart if the circuit is silent, or closer together if the frequency is too high.

Bring a metal item close to the coils. It will be found that one coil causes the tone in the crystal earpiece to rise, while the other causes it to fall, with the overlapping segment offering discrimination between ferrous and non-ferrous metals.

The detector should pick up a large coin (eg, 50c) at up to 150mm (6") in air (125mm is a sure bet), while large metal objects (eg a cake tin) will be detected at half a metre. At close range, it is capable of picking up a pin. When in use, hold the search head close to the ground, sweeping it to and fro. Unlike IB, the two coils give opposite responses to metal, which one soon becomes accustomed to.

While the detector is unusually stable, readjustment by means of VC1 will inevitably be required, particularly immediately after switch-on.

I found this to be a "good natured" metal locator. It was easy to build, easy to set up, and a joy to use.

This project represents a basic implementation of a new idea, and I look forward to seeing designs that develop the concept to its full potential in years to come. **SC**

The patent that came so close – but no cigar!

US Patent 4,196,391 of 1980, by Harold J Weber, was a good piece of original thinking that makes fascinating reading. It came so close to Beat Balance – but no cigar!

The patent describes a metal locator which uses two transmitters, as does ours, balanced by a variable capacitor. However, the patent seeks "least interaction between the inductors", while ours is almost entirely dependent on such interaction.

In the patent, a variable capacitor is used to balance the frequencies of the two transmitters. Ours, on the other hand, uses variable capacitor VC1 to obtain a beat frequency.

The patent mixes the two transmitter frequencies with a third frequency from a Beat Oscillator. The purpose of this is to provide binaural location of metal objects, which is the "primary object" of the patent. Ours obtains an audible heterodyne by mixing the two transmitter frequencies directly, its primary object being to boost sensitivity.

Harold J. Weber states in his patent that he is "surprised" to find "pronounced improvement" by alternating the signals in the ears – for which he employs a Gate Oscillator and a Gate Switch Driver. Why the expression of surprise? It is hardly scientific language.

My hunch is that the pronounced improvement lay not in the ears but in the coils. He considered that he had merely invented another "beat frequency detector type", thus missing a significant breakthrough by a whisker.

The author may be contacted at: **scarboro@lafrica.com**

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097; or send an email to silchip@siliconchip.com.au

Power supply for hot wire cutter

I would like details for making a power supply for cutting polystyrene, for foam core wings and floats for model float-planes, etc. At present I use a 240VAC to 50V transformer, with a slightly modified light dimmer on the secondary side, which works OK but is not particularly stable.

I would like to try using an AT-type computer power supply as the power source. Output voltage would need to be about 26V at a current of about 3A to 5A, with either the voltage or current being adjustable to regulate the temperature of the cutting wire.

Could you make some recommendations for the way in which this could be achieved? Would it require a different winding on the transformer and/or could the output be taken between the +12V and -12V terminals? Output filtering would not be critical. (T. T., Tamworth, NSW).

● Have a look at the Hot Wire Cutter we described in the April 2000 issue. We show you how to use the 12V or 5V outputs of a computer power supply with different types of resistance wire.

Does PIC Programmer do high-end PICs?

I have just successfully built the Portable PIC Programmer kit published in the September 2003 issue. I note that nowhere in the article is it explicitly stated which PIC parts are supported by this hardware and which are not.

I am interested in using the In-Circuit Serial Programming feature with a variety of PIC models. Can the PIC 18FXXX parts be programmed with this unit? If not, what modifications would be necessary? Does the high 13V programming voltage pose a problem for some chips? Any advice on this would be appreciated. (N. R., Gosford, NSW).

● In the "Main Features" box on page 29 of the article, we mentioned that the programmer handles: (1) PIC16F84/A, 16F627/A, 16F628/A, 12F629 and 12F675 micros; and (2) PIC16F87X & 24CXX EEPROMs with user-wired adapters.

However, IC-Prog does support a number of PIC18F parts (check the drop-down list on the main menu and the help file). In theory, you can program these using ICSP and a similar wiring scheme to that shown in Figs.11 & 12.

The programmer is primarily intended as a low-cost beginner's programmer, so use with the high-end micros was deemed unnecessary. As a result, we didn't test any of the PIC18F parts with the programmer & software.

In addition, the large memory sizes in these micros makes programming over an RS232 serial link rather slow. A better choice might be the USB-connected programmer, featured in the April 2003 edition.

As far as we're aware, high-voltage (13V) programming is supported by most devices for backward compatibility reasons. Check the programming specs for your particular device(s), available from **www.microchip.com/1010/suppdoc/specs/index.htm**

Power Transformer For Stereo Amplifier

I have some questions about your SC480 amplifier module. I am thinking of making a stereo amplifier with two modules. However, I have not been able to find a transformer with the right voltage and current (Jaycar recommend their MM-1095 56V CT 134VA transformer).

The problem is that the MM-1095 does not have enough power output to drive the two amplifiers in their worst-case load at once. I could use two of them but there are space and cost considerations. All of the more heavily-rated transformers that could be suitable have 25V secondaries.

What sort of transformer would you recommend to supply power to both at the same time? Would a 160VA 25V toroid (Jaycar Cat. MT-2114) be suitable? Does the fact that the output would be 25V (vs 28V) matter? (B. M., Wellington, NZ).

● While the specified Jaycar transformer is a little light on for a stereo power amplifier driving 8-ohm loads, it is not that far off and would be perfectly adequate if it is just to power a domestic stereo system playing normal program material. On the other hand, if you want to use it with 4-ohm loads and intend using it with a musical instrument, the power rating should be up around 300VA and the voltage should be 28V a side, as specified.

Reducing it to 25V a side will reduce the ultimate power output by about 20%.

Query on amplifier input earthing

I recently built an ETI480 power amplifier as well as purchasing a spare SC480 (January & February 2003). This was as a consequence of the demise of my faithful ETI413 guitar amplifier which failed recently after many years of reliable use.

The preamp module, complete with vibrato and reverb add-ons, was based on an ETI419 preamp and was intended to be used with the new power amplifiers. This preamp uses the 40V bipolar power supply divided to 15V. This is the same output arrangement as the SILICON CHIP 4-Channel Guitar Mixer from January 1992.

I note the later model amplifiers, including the new Studio 350, have a 10Ω resistor which means that the input screen is above ground. If one of these is connected to a preamp us-

Converting A TV To An Oscilloscope

Quick suggestion: maybe you could do a feature or article on converting a cheap or old television set into a crude oscilloscope – not a professional tool, by any means, but just an interesting exercise (educational?) in the workings of a TV, a permanent audio "visualiser" or something to entertain the kids. It can be done easily, especially as the power supply, etc are already present. In fact, here is a website for a home-built CRO:

http://www.dansworkshop.com/Homebuilt%20oscilloscope.shtml

Thanks for the great magazine. Actually, I'm a kid but I would really like the article. (J. H., via email).

● We have produced a number of projects which would interest you. First, to convert a VGA monitor to an oscilloscope, have a look at a series of articles in the July, August & September 1996 issues. Second, have a look at the Sound Card Interface article in August 2002.

Finally, if you want to convert a TV to an oscilloscope, you could look at the Large Screen TV Storage CRO Adaptor published in the February 1982 issue of Electronics Australia.

We can supply the SILICON CHIP back issues for $8.80 each, including postage, or the EA article for the same cost.

ing the same power supply (common 0V), the signal is now applied between input and ground rather than across the input capacitor and resistor plus the 10Ω resistor.

What are the issues (if any) of using the preamps described above? Are any modifications required? (P. E., via email).

● If you only intend using a single 350W module in your proposed guitar amplifier, then the 10Ω resistor can be replaced with a link. The 10Ω resistor has only been included to improve separation between channels in a stereo setup.

Crystal for 50MHz frequency counter

I have recently purchased and constructed your "Low-Cost 50MHz Frequency Counter" from the October 2003 issue. It works but I can't say "no worries". On opening the kit of parts, I was somewhat surprised at the crystal that was supplied. It was a bulk supplied computer crystal not a Hy-Q unit as specified and it certainly does not work like a Hy-Q unit. It cannot be adjusted any closer than 340kHz above 4MHz and no amount of fiddling with extra capacitance will move it more than a few kilohertz.

I rang the kitset supplier and queried the use of such a cheap and nasty crystal for a frequency counter – they may as well be lapped in a concrete mixer for the accuracy that they achieve. For most computer applications it doesn't matter but for a counter timebase the requirement is a bit better than that.

Apart from this aberration, it is great but lacks one thing. It needs to have the low frequency hi-res range extended to about 300Hz to enable the checking of sub-audible tones as they all require the 0.1Hz to be able to be read to ensure that they are correct as some decoders are pretty fussy as to what they will decode. (D. B., via email).

● We suspect that you have a problem with your particular frequency meter. It is either a faulty PIC or faulty software, or the MC10116 is oscillating. The standard crystal will give far better results than the 350kHz error above 4MHz you are obtaining. At most, a 50 ppm crystal (as supplied) would be 2.5kHz out at 50MHz and this would be before any calibration. After calibration to a known frequency, the meter should be better than 10 ppm (ie, within 500Hz at 50MHz).

This has been verified using test equipment (using the low-spec crystal) up to 50MHz. We recommended a low drift crystal so that it would not alter with temperature, however, most kit suppliers are providing a low-cost crystal instead. Readers wanting a better crystal can obtain these from Farnell Electronics or Hy-Q Electronics.

Speech processor for transceivers

I'm attempting to find out about a "Speech Processor for Transceivers" project that was published in the September 1991 issue of "Electronics Australia". Does it provide gain, compression and an "over" beep? I vaguely remember someone doing a project such as this. Can you provide copies of this article? I'm mainly interested in gain as I've changed to a noise-cancelling mike (DSE product) in the tractor cab and the output seems too low. (D. P., Auckland, NZ).

● It does provide gain, compression and beep. We can supply a photocopy of the article for $10, including airmail to New Zealand.

Hot glue as high-voltage insulation

I've just finished building the Remote Touch Lamp Dimmer project from the January & February 2002 issues and would like to ask about the necessity for the suggested "neutral cure silicone sealant" to presumably insulate metal nuts on the PC board. I'm reluctant to purchase a fresh tube because I'll probably not use it again for some time – if at all.

However, I do have some Selleys "No More Gaps" product as well as a hot-glue gun. There's no info as to the make-up of the Selleys product on the label, so I'm not sure if what I have will suffice for the job of insulating the indicated areas on the dimmer's PC board. If "No More Gaps" isn't good enough, will glue from a hot glue gun be OK? (T. R., via email).

● Hot glue will be fine.

Query on SC480 output transistors

If the SC480 was intended as a replacement for the ETI480 50W model, why does it have two output transistors per rail? It is more like the 100W upgrade of the ETI480, as described by ETI magazine. And then why also are the fuses for the unit more like the value needed for the 100W module.

The reason I ask is that I have two damaged ETI480 50W modules I want to replace and I am concerned that the power supply I have will not be adequate for 100W modules. (B. J., via email).

● The SC480 was always intended as a 100W (nominal) module. If you only wanted to drive 8-ohm loads, you could undoubtedly get away with just

two output transistors (and reduce the quiescent current accordingly) but we have not done any tests along these lines. Having the four output transistors also results in lower harmonic distortion when driving 8-ohm loads.

Regulated power supplies in series

I was wondering if it is possible to connect two 0-15V 25A variable regulated power supplies in series to produce a 0-30V 25A variable regulated power supply? (P. J., via email).

● If both power supplies have outputs that are isolated from mains earth, it is probably possible to connect them in series but they must be identical otherwise any current limit will be determined by the smaller supply. If they have earthed outputs and you connect them in series, you run the risk of burning them out.

Battery monitor for can cooler

I am planning on building a can cooler using a Peltier assembly from Oatley Electronics. I would like to add a Car Battery Monitor (December 2003), to keep an eye on the battery voltage so (hopefully) the cooler can be turned off before the battery voltage is too low to start the car. Would it be possible to connect a relay across LED7 (<11.5V) – eg, Jaycar Cat. KG-9142 – to turn off the cooler should the battery voltage fall below 11.5V? Also, will 11.5V be enough to start the car? (J. H., Ipswich, Qld).

● The LED output of the PIC chip will not drive a relay. You will need an NPN transistor and some other components to drive a relay with contacts suited to the current drain of the Peltier device. 11.5V is about the right setting although it might be too low for some of the latest cars.

For a more elegant approach to this circuit problem, have a look at the Battery Guardian in the May 2002 issue.

Speed alarm for a bus

I'm looking to install the Digital Speedometer/Speed Alert kit in a bus which is pretty much all 24V. I was wondering if this would work as it is or would I need to change either or both the 1W resistor or the zener diode that are in the circuit before the 5V regulator. (B. W., via email).

● You will need to change the 16V zener diode to a 33V 1W type. Also, the 5V regulator will run hot and will either need a larger heatsink or must be mounted externally on an aluminium sheet.

Different capacitors in RIAA preamps

A neighbour wants me to build the RIAA version of the Universal Stereo Preamplifier (April 1994). I recalled the same PC board being used in the Studio Twin-Fifty Stereo Amplifier (April 1995) so I went through my library of SILICON CHIP and noted that the value of the bipolar capacitor in series with R4 is 47µF in the first case and 22µF in the latter.

Also, the Universal Preamplifier has a 0.33µF MKT capacitor to output whereas the version in the Twin Fifty amplifier has a 10µF bipolar capacitor. The configuration in the March 2002 RIAA Preamplifier is also subtly different, as is the preamplifier stage in the LP Doctor (January 2001).

My neighbour will use the preamplifier between his turntable and the SoundBlaster card in his computer and I'm hoping that you can advise which circuit is the preferred one. (J. H., Falmouth, Tas).

● The feedback capacitor can be 22µF or 47µF. We specified the larger value in the universal design because its also used in the other preamp configuration.

Similarly, for your application, the output capacitor can be 0.33µF or 10µF. We used the larger value in the later designs because the following stages have some low bass losses.

Controller for 9V Lego trains

Regarding the Li'l Pulser Train Controller from the February 2001 issue, can I adapt this to operate a 9V Lego train instead of 12V trains? (P. H., via email).

● Yes, you can run 9V trains. The speed control will need adjusting to limit the maximum average voltage supplied to the motor. You can do this by increasing the 12kΩ resistor in series with the VR1 speed pot.

This can be achieved by trial and error, using a 20kΩ trimpot in its place and adjusting so that the output maximum to the motor is 9V or less (average as measured with a multimeter set to DC volts) when a train is running on the tracks.

Ignition for Volvo V6

I am considering using the Universal High-Energy Ignition System published in Electronic Projects for Cars, Vol.2. I may also need to use the Programmable Ignition Timing module as well. I am planning to use the systems on an "odd fire" V6 such as that used in Peugeot, Volvo, Renault, etc. I will have to check it but I think the Volvo V6 distributor has a Hall Effect trigger. Will both of the systems mentioned previously operate with a signal that is being supplied at 90-150 degree intervals?

You also mention that one should not use this ignition system with EFI. If the engine has an EFI-only computer then I can't see why it should not all work together, provided that the tacho signal is clean. (T. S., via email).

● If the car runs two coils, you may need two separate ignition systems. If it uses only one coil, then it can be operated from the Hall Effect sensor. The crankshaft angle differences will be catered for with the trigger signal from the car.

The ignition can be run with EFI but we took the view that the original ignition system would be best. The High Energy Ignition was intended for replacing the old Kettering (points/coil) system or cars with Hall or reluctor triggers that did not run full computerised EFI and ignition.

Woofer Stopper won't work on deaf dogs

I have just successfully completed a Woofer Stopper Mk2 (February 1996). I now wish to increase the output. I have only one piezo tweeter (KSN 1005A) connected at present but the

2-way crossover problem

I've run into a problem with my bookshelf speakers currently being built. They are 2-ways and the mid-woofer I am using is 8Ω, while the tweeter is 6Ω. The sensitivity of the woofer is 88dB and the tweeter sensitivity is 91dB. The crossover frequency is 3.5kHz.

I will be running these off a Pioneer VSX-D409 receiver. I have asked many people on how to attenuate the tweeter and bring the sensitivity closer to the woofers. One person with the same speakers recommended to put a 2.2Ω 10W resistor before the tweeter but Jaycar says "No, if the tweeter is drawing 100W, the amplifier may blow".

Information on the Mid-Woofer is available at:
http://www.advanceae.com.au/car/prod395.htm

Information on the tweeter is at:
http://www.advanceae.com.au/car/prod385.htm

I need your help! (P. W., via email).

● The series resistor is the correct approach but since there is a 3dB difference in sensitivity, the resistor should be close to 6Ω rather than 2.2Ω. However, since this changes the tweeter circuit impedance, it will also change the crossover frequency so you will also have to reduce the tweeter capacitor to bring it back to 3.5kHz (or whatever).

effect on the dogs doesn't seem to be enough. Should I be considering the KSN 1177A TD? Any advice would be greatly appreciated. (P. L., via email).

● You can use several KSN1005A tweeters in parallel (ie, connect the red plus terminal of one tweeter to the red terminal on each of the other tweeters. Similarly connect the negative terminal on each tweeter together).

You can use three or four units for more sound level. Note that if the dog does not respond to the noise at close range then it may not respond even if the noise is made louder with more tweeters. This is because some dogs are deaf to ultrasonic frequencies. Many old dogs are completely deaf.

Voltage hysteresis in Battery Guardian

I have constructed a Battery Guardian kit (May 2002). The main question is how can I decrease the hysteresis of the "reset" value? The reset value I would like to achieve is about 1.1V. The closest I can get at the moment is 1.6V. I have tried increasing the 2.2MΩ but this hasn't given me the desired result. I realise it would be a "ratio" situation but I can't figure out which resistors are involved.

A friend has also constructed this kit and has suggested that an "input" diode on the positive leg would protect the circuitry against accidental wrong connection. (P. C., via email).

● An input diode will affect the voltage measurement and this would need to be accounted for in the setting up.

The hysteresis can be reduced by changing the 220kΩ resistor between pins 1 and 3 of IC2a to 470kΩ. This should reduce the voltage sensing hysteresis to around 1V.

Windows-based EPROM programmer query

I have just recently complete the EPROM Programmer project (November & December 2002, February 2003). I find that when power is applied to it, REG3 and Q15 get fairly hot.

By looking at the circuit diagram I can't see how these components could possibly draw excessive current. The output of REG3 is 12.9V and the power LED is glowing. I have not inserted an EPROM chip nor have I attempted to connect the programmer to a computer. Both of the relays switch when power is applied.

Could you please help me? (G. H., via email).

● If you run the EPROM Programmer without connecting it to a PC, this tends to turn on both Q15 and Vpp pass transistor Q5 at the same time – something that normally doesn't happen when the programmer is connected to a PC. As a result, Q15 can draw significant current from the Vpp supply and both it and REG3 will get quite warm.

This isn't a fault, just something that happens when the programmer isn't connected to a PC when it's powered up. The two relays energise for the same reason. So there shouldn't be a problem with your programmer when it's used in the normal way.

Avoid the use of sports coils

I have a Hall Effect or reluctor ignition system (standard on 1986 Nissan Bluebird). The local auto electrician does not want to sell me a sports coil because he thinks the electronics cannot handle it. Can you give me an opinion on this and how one might ensure the electronics can cope or maybe how to upgrade them? (G. K., Stratford, NZ).

● Your auto electrician is correct. We also do not recommend sports coils for use with our High Energy Ignition system. The primary coil current is significantly higher than with standard coils and the output voltage higher. This leads to less reliability.

Generally sports coils can only be used with ignition systems designed to use them or they can be used with points although points life will be short.

Mains tone interference to PA amplifier

I am having a problem with the control tones put on the mains by the electricity supply authority breaking into a PA amplifier. I think the frequency is 1050Hz. I understand that the problem can be cured by winding the supply flex through and around a toroid but I am not sure what size toroid or the number of turns. Can you help? (K. C., via email).

● It is extremely doubtful whether any simple filtering on the mains input to your PA amplifier is going to solve the problem. The problem is more likely to be radiation from the mains wiring in the building directly into the mic input wiring. Balanced mics will certainly help, as well as routing the mic cables away from any mains wiring, cables or transformers.

DIY car amplifier not economic

I am looking for a circuit for my major project for Year 12. Does SILICON CHIP have an amplifier which can be used to decently run a 12-inch sub-

woofer in a car? Also do you have any kits which can be hooked up to a sub equaliser?

I know Jaycar has a kit but I don't know if it can be hooked up to an amplifier kit in a car system. Any help would be appreciated. (J. D., Port Macquarie, NSW).

● We have described a number of modules which could be used to drive a subwoofer, with the recent Studio 350 being a good example. However, to run this amplifier you would need a high power DC-DC inverter and by the time you built both, it would be much cheaper to buy a car subwoofer amplifier from Jaycar. As an alternative, you might like to consider building a project or two from our "Electronic Projects for Cars" handbook.

10-cell Nicad charger wanted

Having joined the radio control fraternity over the last 12 months, it is apparent that batteries and battery chargers have improved dramatically. You can buy very small chargers that will handle Nicads, NiMH, SLA and Li-ion that run from a car battery. The added advantage seems to be that you can charge packs of greater voltage than the car battery can supply; eg 10 NiMH cells, at up to 3A.

Have you published a design that can charge eight 1.2V cells from a car battery? With the growth of electric flight and the demands for charging batteries, a 12V-based project that can handle the newer battery packs would be greatly appreciated by many modellers out there. (A. B., via email).

● We have published a 12V Nicad charger which will cater for up to 10 cells, in the October 1995 issue. It uses a Philips TEA1100 chip. You should make sure you can obtain that chip before you purchase the other major parts. We can supply the October 1995 issue for $8.80 including postage.

Notes & Errata

3-Way Active Crossover, January 2003: the equation for the crossover frequency shown in Fig.4 is incorrect. It shows the whole bottom line within the square root symbol whereas only the 2 should be within the square root.

Simple DC Power Supply, March 2004: a track is missing on the PC board layout between the anode of D5, cathode of D6 and the output of REG1. The corrected PC board pattern is shown at right.

This error was also present in the PSU.ZIP design files mentioned in the article. An updated version can be downloaded from **www.siliconchip.com.au**

Current Clamp Adaptor For DMMs, September 2003: as presented, the clamp adaptor is not suitable for use with 240VAC mains when the wiring is uninsulated. To make it safe, both the metal clip and the toroid must have insulating coatings.

Battery backup for cordless phones

Recently, a storm passed over the Riverina which blacked out the area for an hour or so. During this time, I was unable to use my only phone which derives its power from the mains. If a fire had started, I would have been unable to report it.

Has SILICON CHIP ever printed an article on a low-power 230VAC inverter (say 5-10W and with sinusoidal waveform) which could be used as a "no break" power supply for essential services? If not, would you consider giving it a run? (D. V., via email).

● We would not produce a low power sinusoidal DC-AC inverter, as we don't think its sales would justify the work required. However, you might like to look at the project entitled "Backup Battery For Cordless Phones" which does address your problem, in the October 1999 issue. This was followed in the December 1999 issue (Circuit Notebook pages) with a version for AC-powered cordless phones.

More simply, you might also want to have a conventional phone installed so that you can still dial out in these circumstances. SC

WARNING!

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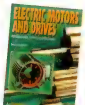

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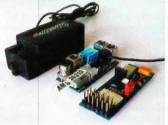

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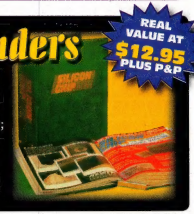

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Advertising Index

Acetronics 94
Altronics 70-72
Av-Comm 95
Carba-Tec Tools 96
Dick Smith Electronics 14-17
Eco Watch 95
Elan Audio 41
Elexol 43
Evatco 75
Gadget Central ..... IFC
Grantronics 94
Harbuch Electronics 55
Hy-Q International 57
Instant PCBs 96
Jaycar 45-52,57,96
JED Microprocessors 5,57
Kalex 75
Microgram Computers 3
MicroZed Computers 13,43
Newtek Sales 65
Oatley Electronics 23
Ozitronics 37,43
Prime Electronics 79
Quest Electronics 57,95
RCS Radio 96
RF Probes 75
Silicon Chip Back Issues 92-93
Silicon Chip Binders 65,69
Silicon Chip Bookshop 90-91
SC Car Projects Book 32,IBC
Silicon Chip Subscriptions 44
SC Electronics Testbench 77
Silvertone Electronics 94
Soundlabs Group 57
Speakerbits 95
Taig Machinery 95
Telelink Communications ... OBC,57
WIA 57

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